FOR CONTRACT NO.: 05-0R9104

INFORMATION HANDOUT

MATERIALS INFORMATION

1. Geotechnical Report for Concrete Slab with Cut-off Wall Alternative, Locations 3 and 4, dated November 4, 2011

2. Quickchange Moveable Barrier Series 200

3. Alternative Terminal Systems
   A.Type Fleat Terminal System
   B. Type SRT Terminal System
   C. Type X-Tension Terminal System

ROUTE: 05-SCr-1-9.7/17.6

Memorandum

Flex your power!

Be energy efficient!

To: BORIS AYAVIRI
Project Development
Design II, Branch V
San Luis Obispo

Attn: Gerardo Gomez
Design Engineer

Date: November 4, 2011

File: 05-SCr-1-9.0/17.6
Concrete Barrier/Guardrail
05-0R9100

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Concrete Slab with Cut-off Wall Alternative, Locations 3 and 4

This memo provides additional geotechnical information regarding the feasibility of the preferred concrete slab with cut-off wall alternative, at locations 3 and 4 to the immediate east and west of Aptos Creek on Highway 1, between postmiles 9.80 and 10.01, Santa Cruz county. Geotechnical recommendations are provided for the above alternative based on observed subsurface conditions and potential for erosion. This memo is preceded by a District Preliminary Geotechnical Report (DPGR) and supplemental DPGR submitted on June 10, 2009 and July 15, 2010 respectively. These previous reports document preliminary geotechnical conditions and recommended alternatives for upgrade of existing metal beam guardrail (MBGR) and concrete barrier walls between PM 9.0/17.6 along Highway 1, in Santa Cruz County. The reader should refer to these reports for additional background information.

The relative density of subsurface embankment fill was estimated along the proposed alignment of the concrete barrier slab-cut-off wall at locations 3 and 4 using a whacker-driven 1.25-inch diameter probe with conical tip. The rate of advancement in seconds per foot was documented at marked 50-ft intervals, to five-feet below the surface, along the length of the alignments, with exception to areas where embankment slope was non-existent or minimal, or drainage inlets existed.

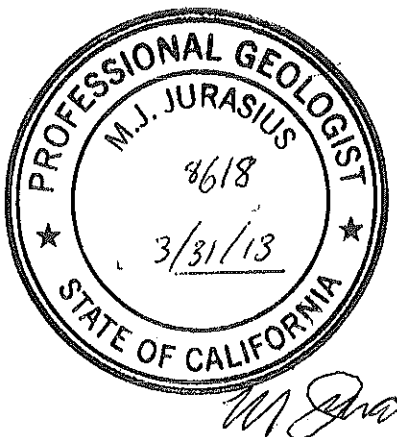
Location 3 extends along the outside shoulder of northbound Highway 1 between the Union Pacific railroad over-crossing and Aptos Creek Bridge. Embankment slopes along most of this alignment, parallel to Valencia Creek, are 1.5:1, and composed of loose, Well Graded, rounded GRAVEL with SAND and COBBLE. Loose to medium dense

conditions exist along the proposed cut-off wall alignment to depths of five-feet and greater.

The proposed barrier slab-cut-off wall at location 4 extends about 400-ft from the western abutment of Aptos Creek bridge; the alignment coincident to an existing culvert pipe between Sta. 30+35.6 and 31+19.58. Test locations were off-set a couple feet south of the proposed wall alignment between the above locations. Embankment fill material along the cut-off wall alignment appears to be mostly loose to medium dense silty SAND with trace fine GRAVEL on an average 1.5:1 slope. Five test locations were selected between Sta. 29+86 and 30+86 at 25-ft intervals and advanced to 5-feet. Embankment material at this location was observed to be denser and more consistent than Location 3.

A three-foot cut-off wall is recommended at both locations 3 and 4. Two-feet of over-excavation along the cut-off wall alignment is recommended only at location 3. Backfill should follow the guidelines of Section 19-3.02B in the Caltrans 2010 Standard Specifications. Gravels and Cobbles should be removed from existing embankment materials before placement against the cut-off wall and compacted per Section 19.6.03C. Erosion control is recommended in all areas where disturbed soils are exposed.

If you have any questions or comments, please contact Mike Jurasius at (805) 549-3729 or Mike Finegan at (805) 549-3194.



Supervised by,

Michael J. Jurasius, PG
Engineering Geologist
Geotechnical Design – North
Branch D

MIKE FINEGAN, PE
Geotechnical Design - North
Branch D

C: Igor Cherniogl – Structures Design

Quickchange Moveable Barrier

The QMB system is designed to create a positive traffic barrier between opposing lanes of traffic and between motorists and construction work areas. The Barrier Transfer Machine (BTM) laterally transfers the barrier wall, one lane or more, at speeds of up to 7 mph (11 km/h). This allows the roadway to be reconfigured to maximize the number of traffic lanes in the peak traffic direction and to make the road system operate more efficiently. The Reactive Tension System Quickchange® Moveable Barrier (RTS-QMB) is used in both permanent and construction applications. RTS-QMB creates managed lanes that cost effectively increase highway capacity and reduce congestion by making more efficient use of new or existing roadways. These applications include high volume highways were additional right-of-way may not be available, where environmental concerns may exist, or where the lack of funding may slow or inhibit support for new construction. Moveable barrier provides a "fast-build" solution for improving highway capacity without having to wait for time consuming study reviews. For construction applications, RTS-QMB is designed to accelerate construction, improve traffic flow and safeguard work crews and motorists by positively separating the work area and traffic. RTS-QMB reduces work zone congestion by enabling more lanes to be open during peak hour traffic. The work zone can be expanded during off peak periods, providing greater access for work crews which speeds construction.

Crash Cushion ABSORB 350

ABSORB 350 is a non-redirective, gating crash cushion that offers maintenance workers and contractors a reliable and easy method to protect the ends of concrete barriers. At two feet wide, it is ideally suited for narrow areas where road and workspace are limited. The ABSORB 350 is easier to restore after an impact than other non-redirective, gating crash cushions.

Quotations (for estimating purpose only) :

	6 Mo.	**Additional Mo.**
Construction Barrier Transfer Machine	$103,000	$14,000
Construction Quickchange Moveable Barrier	$42 per foot	$3.60 per foot

	TL-2	TL-3
ABSORB-350 Crash Cushion sale cost:	$5,000	$7,400
ABSORB-350 Crash Cushion rental cost:	Contact Statewide Safety 522 Inga Road Nipomo, CA 93444 800-559-7080	

Quotation provided by:

Byron F. West Jr.
Western States Regional Manager
Office: 541-899-0888
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Corporate Office Contact Info

BARRIER SYSTEMS INC

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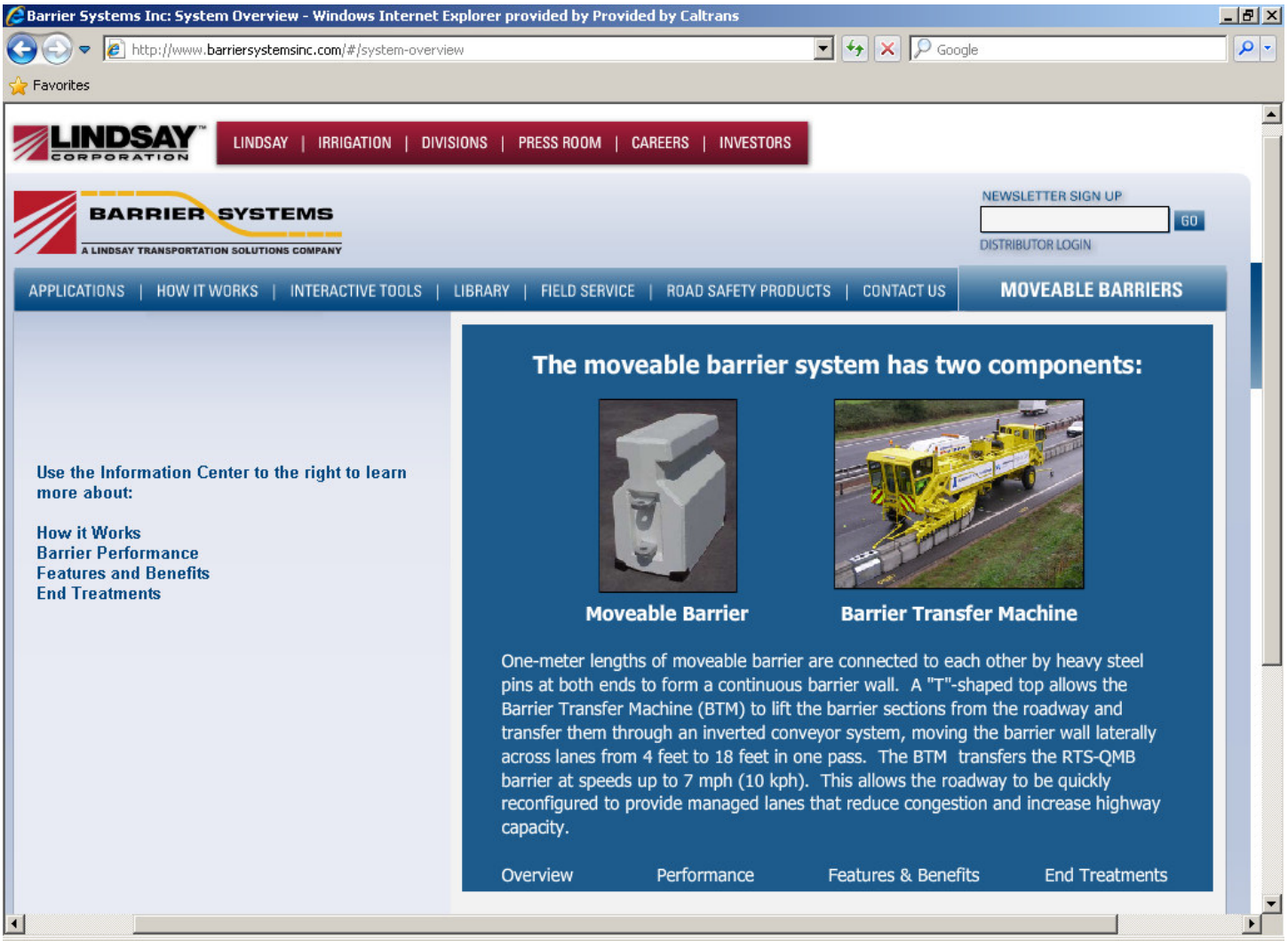
Fax.: (707) 374-6801
Email: info@barriersystemsinc.com



This section of the information handout shows three alternative flared terminal systems shown in the Non-Standard Special Provision (NSSP) Alternative Flared Terminal System for this project EA 05-0R9104. For more information refer to the Contract Special Provisions, the manufacturers of each terminal system and the Engineer.

The three alternative terminal system and their respective manufacturers are:

1.) TYPE FLEAT TERMINAL SYSTEM – Type FLEAT terminal system must be a Flared Energy Absorbing Terminal 350 manufactured by Road Systems, Inc., located in Big Spring, Texas, and must include items detailed for Type Fleat terminal system shown on the plans. The Flared Energy Absorbing Terminal 350 can be obtained from the distributor, Universal Industrial Sales, P.O. Box 699, Pleasant Grove, UT 84062, telephone (801) 785-0505 or from the distributor, Gregory Industries, Inc. , 4100 13th Street, S.W. Canton, OH 44708, telephone (330) 477-4800.

2.) TYPE SRT TERMINAL SYSTEM - Type SRT terminal system must be an SRT-350 Slotted Rail Terminal (8-post system) as manufactured by Trinity Highway Products, LLC, and must include items detailed for Type SRT terminal system shown on the plans. The SRT-350 Slotted Rail Terminal (8-post system) can be obtained from the manufacturer, Trinity Highway Products, LLC, P.O. Box 99, Centerville, UT 84012, telephone (800) 772-7976.

3.) TYPE X-TENSION TERMINAL SYSTEM - Type X-Tension terminal system must be an X-Tension Guard Rail End Terminal as manufactured by Barrier Systems, Inc. located in Vacaville, CA, and shall include items detailed for terminal system (Type X-Tension) in conformance with manufacturer's details and as shown on the plans. The X-Tension guard rail terminal can be obtained from the distributor, Statewide Traffic Safety and Signs, Inc., 130 Grobric Court, Fairfield, CA 94533, telephone (800) 770-2644.

Installation Instructions

for the

FLEAT 350

R O A D S Y S T E M S , I N C .

P. O. Box 2163

Big Spring, Texas 79721

Phone: (432) 263-2435 FAX: (432) 267-4039

Technical Support & Marketing Phone: (330) 346-0721

Technical Support & Marketing Fax: (330) 346-0722

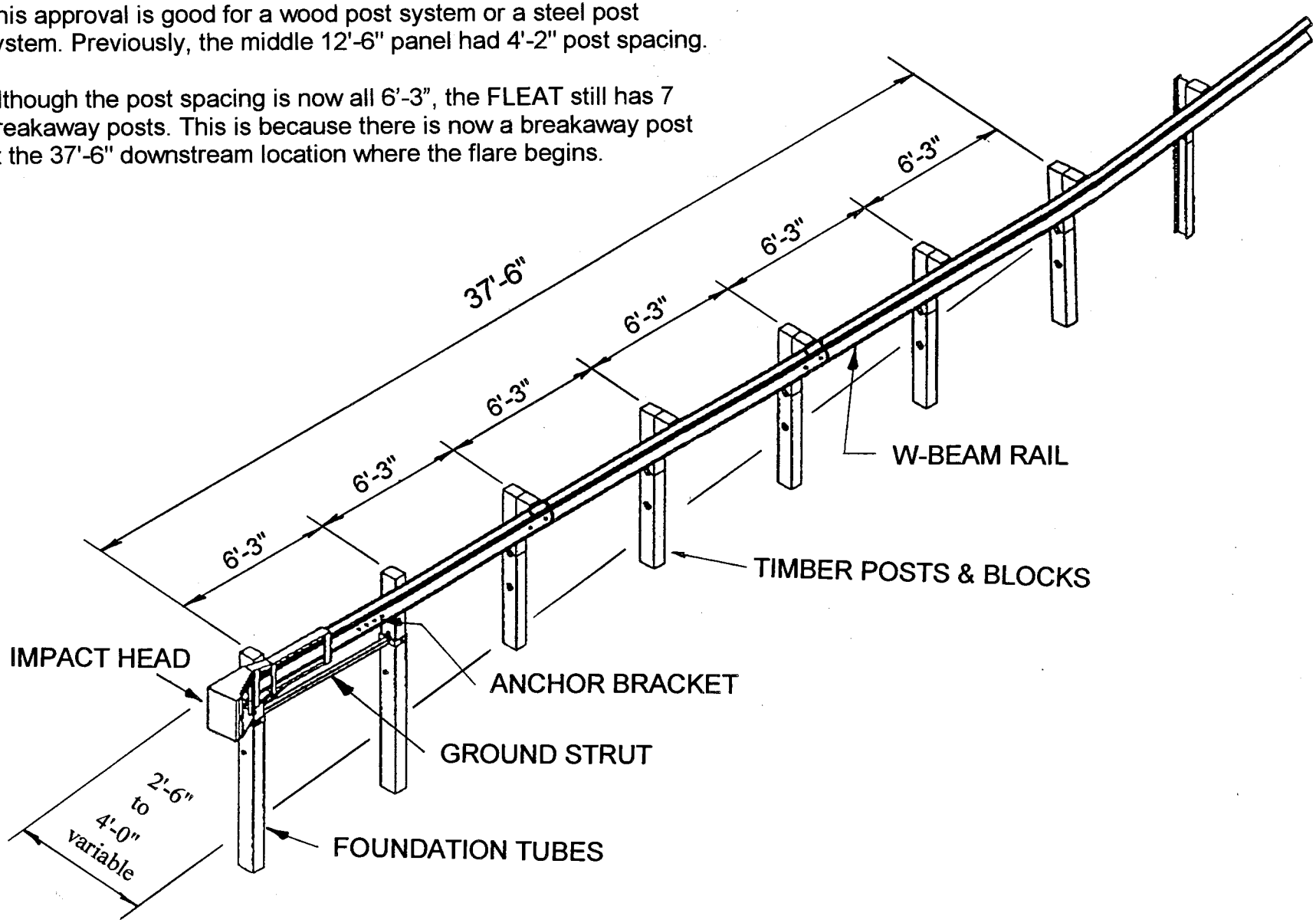
This Installation Manual can be downloaded from RSI web site
www.roadsystems.com

ADDENDUM

June 2001

The **FLEAT** may now be installed with **all 6'-3" post spacing**. This approval is good for a wood post system or a steel post system. Previously, the middle 12'-6" panel had 4'-2" post spacing.

Although the post spacing is now all 6'-3", the FLEAT still has 7 breakaway posts. This is because there is now a breakaway post at the 37'-6" downstream location where the flare begins.



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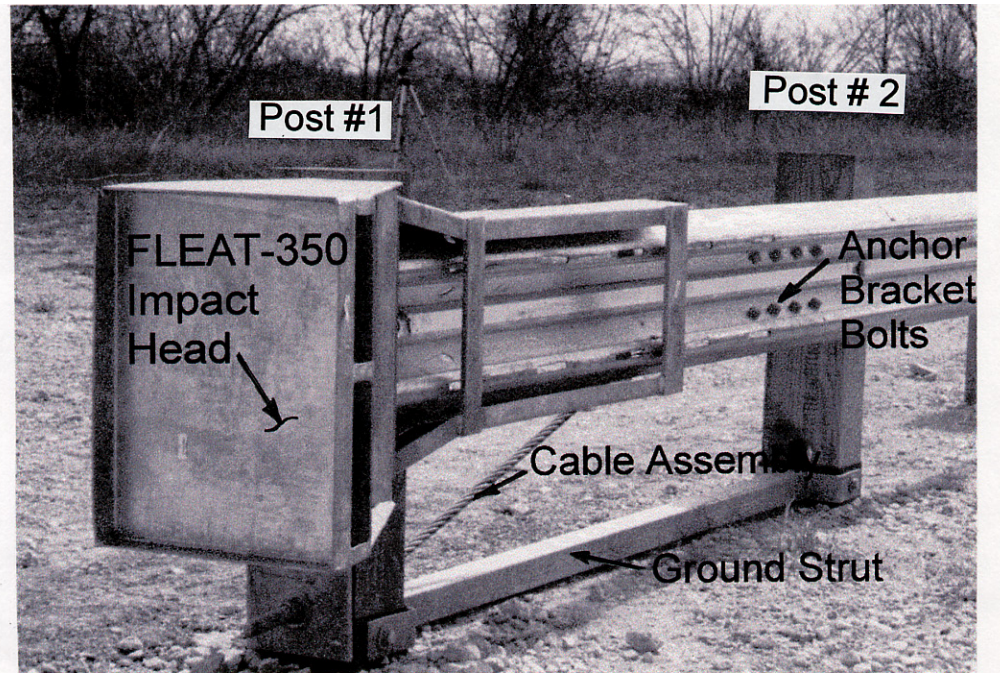


Figure 1. Isometric view of the *FLEAT 350.*

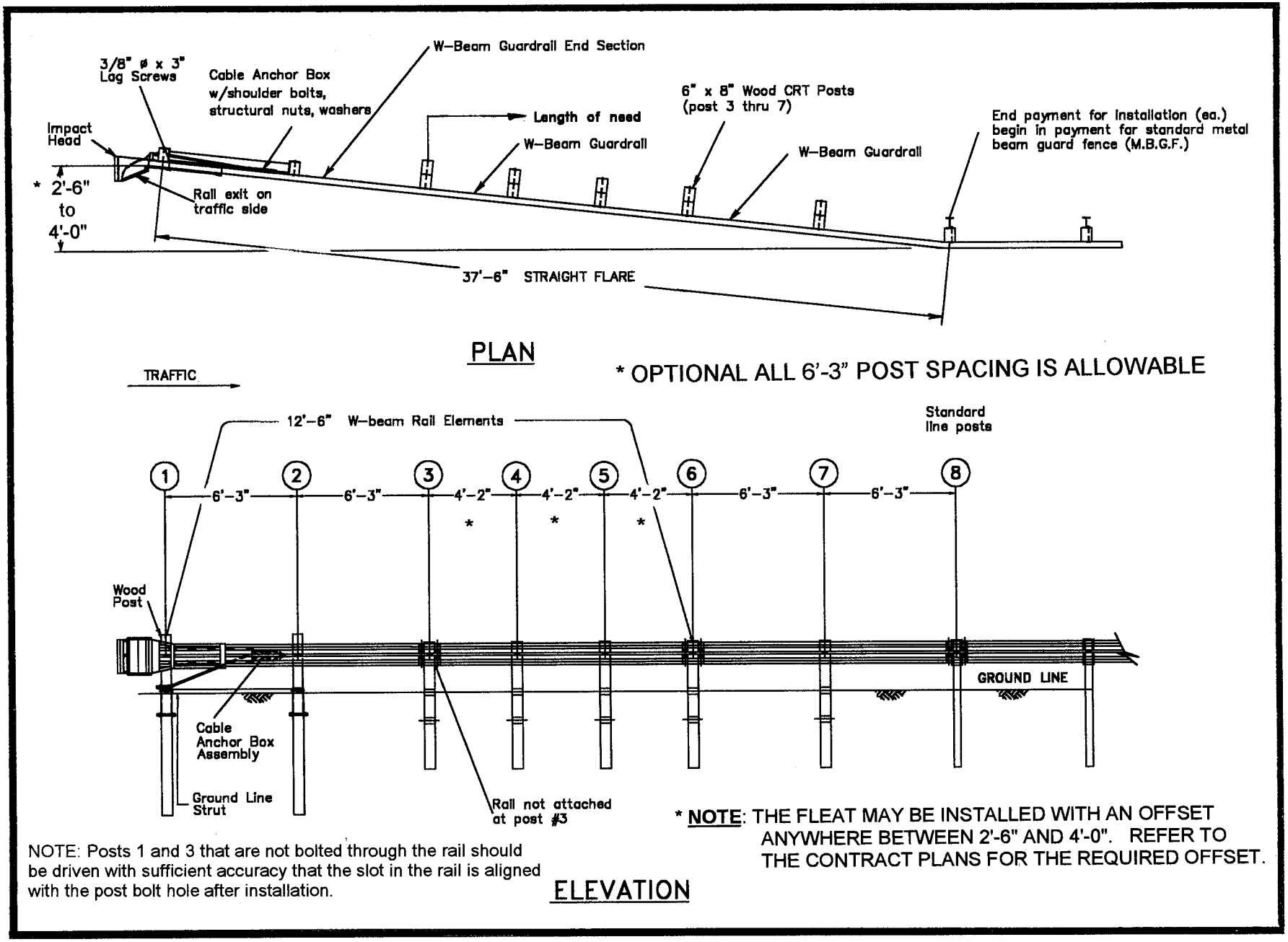


Figure 2. Plan and Elevation Views of *FLEAT 350.*

Installing the *FLEAT 350*

Materials

As packaged, the ***FLEAT 350*** system includes all materials needed for a complete installation except for the impact face object marker. The length of the system in this configuration is 37'-6".

Design Options

There are four foundation tube options as shown in **Table 1** below.

Table 1. *FLEAT 350* Design Options

FLEAT 350 **Design Options**	Total Foundation Tubes	Number of Standard BCT Posts	Number of CRT Posts	Total Number of Posts
6'-0" split Foundation Tube	2	2	5	7
6'-0" solid Foundation Tube	2	2	5	7
5'-0" or 4'-6" Foundation Tubes with soil plate	2	2	5	7

Figure 6 shows a section with the 6'-0" foundation tubes.

Figure 7 shows a section with the 5'-0" or 4'-6" foundation tubes with soil plates.

Table 2. *FLEAT 350* Bill of Materials

Code #	Quantity	Description
F3000	1	Impact Head
F1303	1	W-Beam Guardrail End Section, 12 Ga., 12-6"
F1304	1	W-Beam Guardrail, Center Section (4'-2" spacing) 12 Ga., 12'-6"
G1203	1	W-Beam Guardrail, (6'-3" spacing) 12 Ga., 12'-6"
S730	2	* Foundation Soil Tubes, 6" x 8" x 6'-0" **(SEE NOTE BELOW)**
E740	1	Pipe Sleeve - 2″ Standard Pipe x 5-1/2″
E750	1	Bearing Plate - 8″ x 8″ x 5/8″
S760	1	Cable Anchor Bracket
E770	1	BCT Cable Anchor Assembly
E780	1	Ground Strut
P650	2	5-1/2″ x 7-1/2″ x 45″ Wood Posts
P671	5	6" x 8" x 6'-0" Wood CRT Posts
P675	5	6" x 8" x 14" Timber Blockouts
Hardware	* The optional **6'-0" long split** foundation tubes may be substituted with either **solid 6'-0" long** foundation tubes without soil plates or standard **5'-0" long** or **4'-6" long** foundation tubes with soil plates.	
B580122	24	5/8″ x 1¼″ Splice Bolts
B580754	2	5/8″ x 7½″ Hex Bolts
B581004	2	5/8″ x 10″ Hex Bolts
B581002	1	5/8″ x 10″ H.G.R. Post Bolt (Post 2 Only / NO BOLT USED AT POST #1)
B581802	5	5/8″ x 18" H.G.R. Post Bolts (Posts 3 through 7)
N050	34	5/8″ H.G.R. Nuts (Splice - 24, Soil Tubes - 4, Posts 2 to 7 - 6)
W050	10	5/8″ Flat Washers (2 each at Soil Tubes + 6 Posts)
N100	2	1″ Anchor Cable Hex Nuts
W100	2	1″ Anchor Cable Washers
E350	2	3/8″ x 3″ Lag Screws
SB58A	8	Cable Anchor Bracket Shoulder Bolts
N055A	8	1/2" A325 Structural Nuts
W050A	16	1-1/16" OD x 9/16" ID A325 Structural Washers

Site Preparation

The ***FLEAT 350*** is installed with a **straight flare offset anywhere between 2'-6" and 4'-0". Refer to the contract plans for the required offset**. Simply measure the offset distance over the 37'-6" length with a straight string line. This offset becomes the location of post #1. A parabolic curve is not required. Minor site grading may be necessary to prevent the foundation tubes from extending more than 4″ above the ground (see Section on Installation).

Tools Required

The tools required for installation of the ***FLEAT 350*** system are those used to install standard highway guardrails (H.G.R.), including: 9/16", 7/8", 15/16", 1-1/4", and 1-1/2" sockets and wrenches, a drill with a 1/4″ bit, and other equipment such as augers, tampers, and post pounders commonly used in driving posts.

Installation Procedures

Begin installation at the downstream end of the ***FLEAT 350*** (post location 8) to ensure that the terminal matches up with the standard section of guardrail. The major steps in the installation of the ***FLEAT 350*** are as follows:

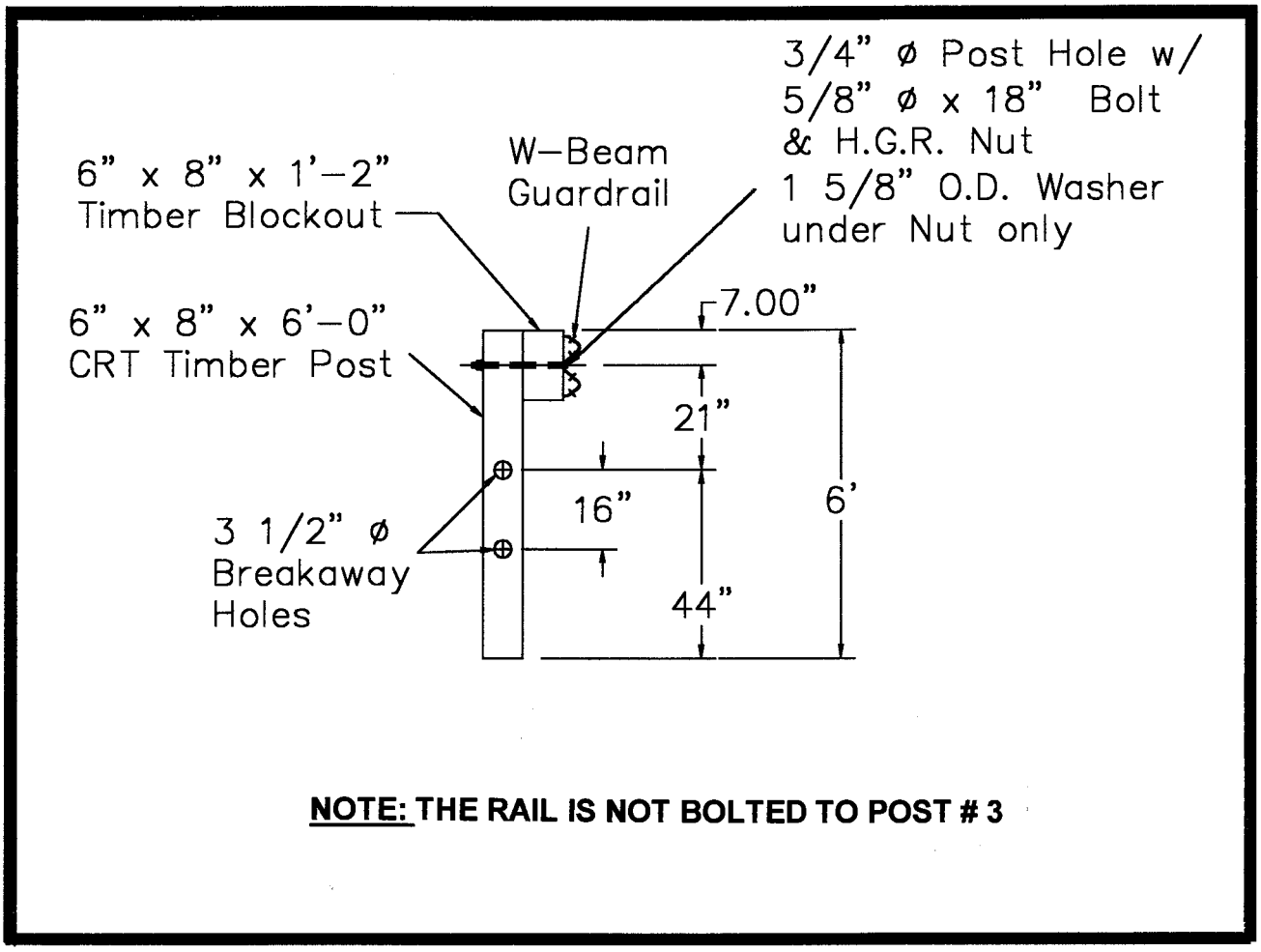
- Install posts 3 through 7,
- Install posts 1 and 2 with groundline strut,
- Install guardrail,
- Install cable anchor bracket,
- Install the ***FLEAT 350*** impact head, and
- Install cable assembly.

NOTE: The impact head must be placed over the rail prior to tightening the rail to post # 2.

Installing Posts 3 Through 7

Posts 3 through 7 are 6" x 8" x 6'-0" CRT posts (P671). When installed properly, the hole at the ground line of these CRT posts will be parallel to the roadway. **Figure 3** shows the section of a CRT post. The CRT post may be driven with an approved driving head. For stiff soils, drill a 6″ pilot hole and force the post to the appropriate depth by impact or vibratory means with an approved driving head. The post may also be installed by augering and backfilling if the contractor so prefers. The initial hole must be large enough to allow adequate room for proper compaction of the soil during backfill. *Care must be taken to carefully compact the backfill to prevent settlement or lateral displacement of the post.*

If rock is encountered during driving or excavation, refer to appropriate State specifications. Guidelines will vary from State to State.



SECTION TYPICAL AT POSTS 3 - 7

Figure 3. Section at CRT Post

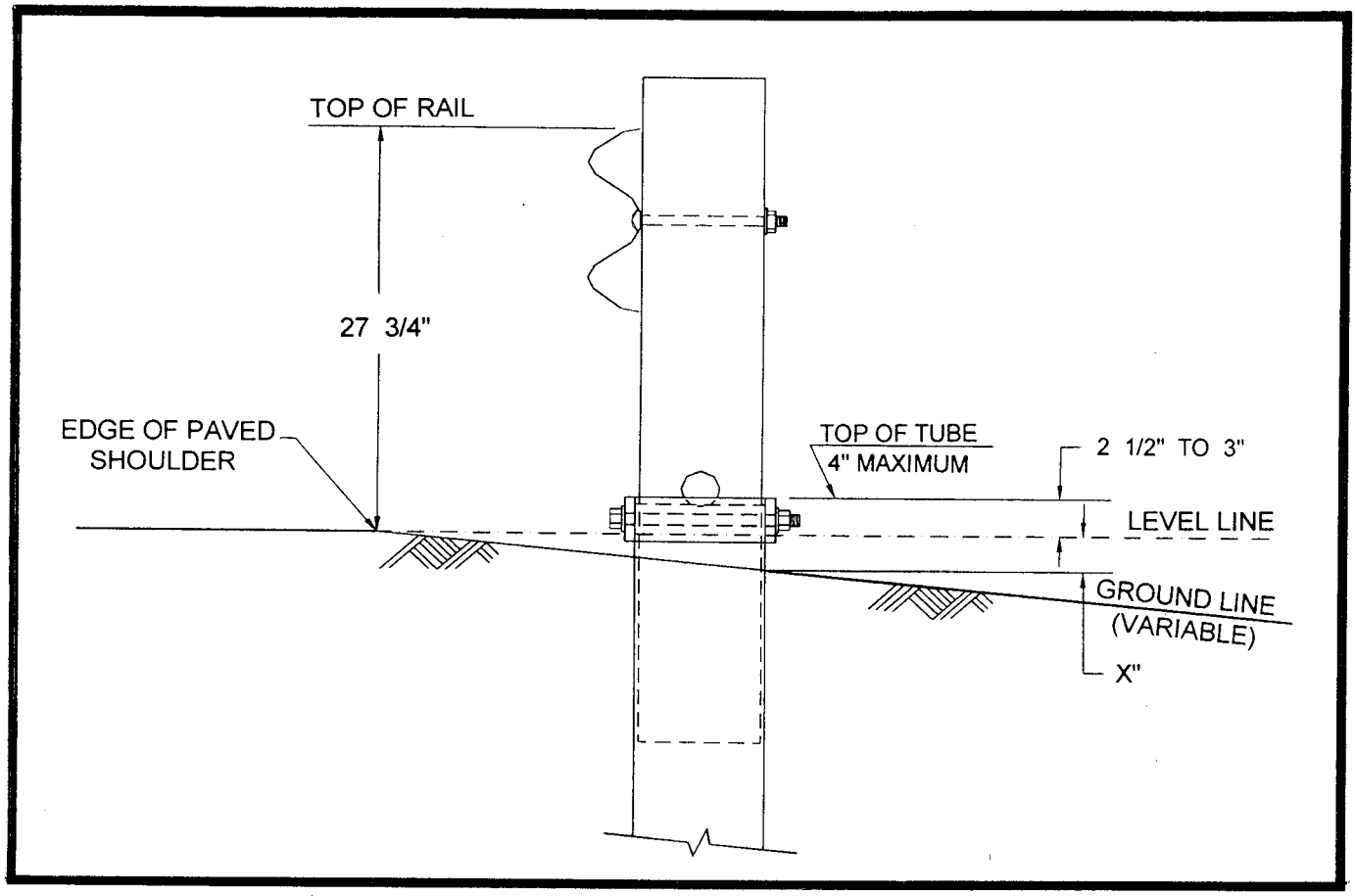


Figure 4. Proper Placement of Foundation Tubes

Figure 4 illustrates the proper placement of the foundation tubes. The top of the foundation tubes should not project more than 4″ above the ground line when measured along a 5' cord, according to AASHTO specifications. Site grading may be required if the top of the foundation tubes project more than 4″ above the ground line. The finished guardrail height should generally be 27-3/4″ above the edge of the shoulder.

Based on a level line from the edge of the paved shoulder, the top of the foundation tube should normally be 2-1/2″ to 3″ above the level line. The placement of the foundation tube should be an appropriate depth below the level line in order to maintain the 27-3/4" guardrail height from the edge of the shoulder.

If the slope drops off some distance (*X* ") from the edge of the shoulder to the tube location, as shown in **Figure 4**, the depth of the foundation tube should be reduced by *X* ″ in order to maintain the proper guardrail height. The top of the foundation tube will project *(X″*+ 2 1/2") to *(X″*+ 3") above the ground. In order not to exceed the AASHTO 4″ maximum projection above the ground, site grading will be necessary to assure that the "*X* ″ dimension would not be more than 1 1/2" to 1″ respectively.

Installing Posts 1 and 2 with Groundline Strut

Figure 5 shows the above ground details and **Figure 6** shows the section at post locations 1 and 2. Posts 1 and 2 may be installed with either 6'-0" long split foundation tubes (S730) without soil plates, solid 6'-0" long foundation tubes (E731) without soil plates, standard 5'-0" long foundation tubes (S735) with soil plates (SP600) or 4'-6" long foundation tubes (E735) with soil plates (SP600). **Figure** 7 shows the optional 5'-0" or 4'-6" foundation tubes with soil plates.

For the **6'-0" long split foundation tube**, fasten one 5/8" x 7-1/2" hex head bolt (B580754) and H.G.R. nut (N050) through the bottom hole of the foundation tube. *Do not over tighten and deform the tube*. The bolt is intended to stop the post from sliding all the way into the tube during installation.

Do not drive the foundation tube with wood post inserted. If the soil is penetrable so that the foundation tube does not deform, the foundation tube may be driven with an approved driving head. For non-penetrable soil, drill a 6" pilot hole and force the tube to the appropriate depth by impact or vibratory means with an approved driving head. The tube may also be installed by augering and backfilling if the contractor so prefers. The initial hole must be large enough to allow adequate room for proper compaction of the soil during backfill. *Care must be taken to carefully compact the backfill to prevent settlement or lateral displacement of the foundation tubes.* If rock is encountered, refer to appropriate State specifications. Guidelines will vary from State to State.

The top of the foundation tubes should not project more than 4" above the ground line when measured along a 5' cord, according to AASHTO specifications (see **Figure 4**).

The installation procedure for the **solid 6'-0" long foundation tubes** without soil plates is the same as that for the split foundation tubes.

The installation for the **standard 5'-0" long foundation tubes** with soil plates or the **standard 4'-6" long foundation tubes** with soil plates is shown in **Figure** 7. Fasten the soil plate to the foundation tube with two 5/8" x 7-1/2" hex head bolts (B580754) and H.G.R. nuts (N050) through the bottom holes of the foundation tubes. *Do not over tighten and deform the tubes.* These bolts attach the soil plate to the foundation tube and stop the post from sliding all the way into the tube during installation.

Insert the pipe sleeve (E740) into the 2 1/2" diameter hole near the base of the 5-1/2" x 7-1/2" x 45" wood post (P650) and install the post in the foundation tube at post location 1. Install the second 5-1/2" x 7-1/2" x 45" wood post in the foundation tube at post location 2, and fit the groundline strut (E780) between the two posts. Secure the post to each foundation tube with a 5/8" x 10" hex head bolt (B581004) and H.G.R. nut (N050) with a washer (W050) under both the bolt head and the nut. These bolts will serve to secure the posts and attach the groundline strut to the foundation tubes, as shown in **Figure 6**.

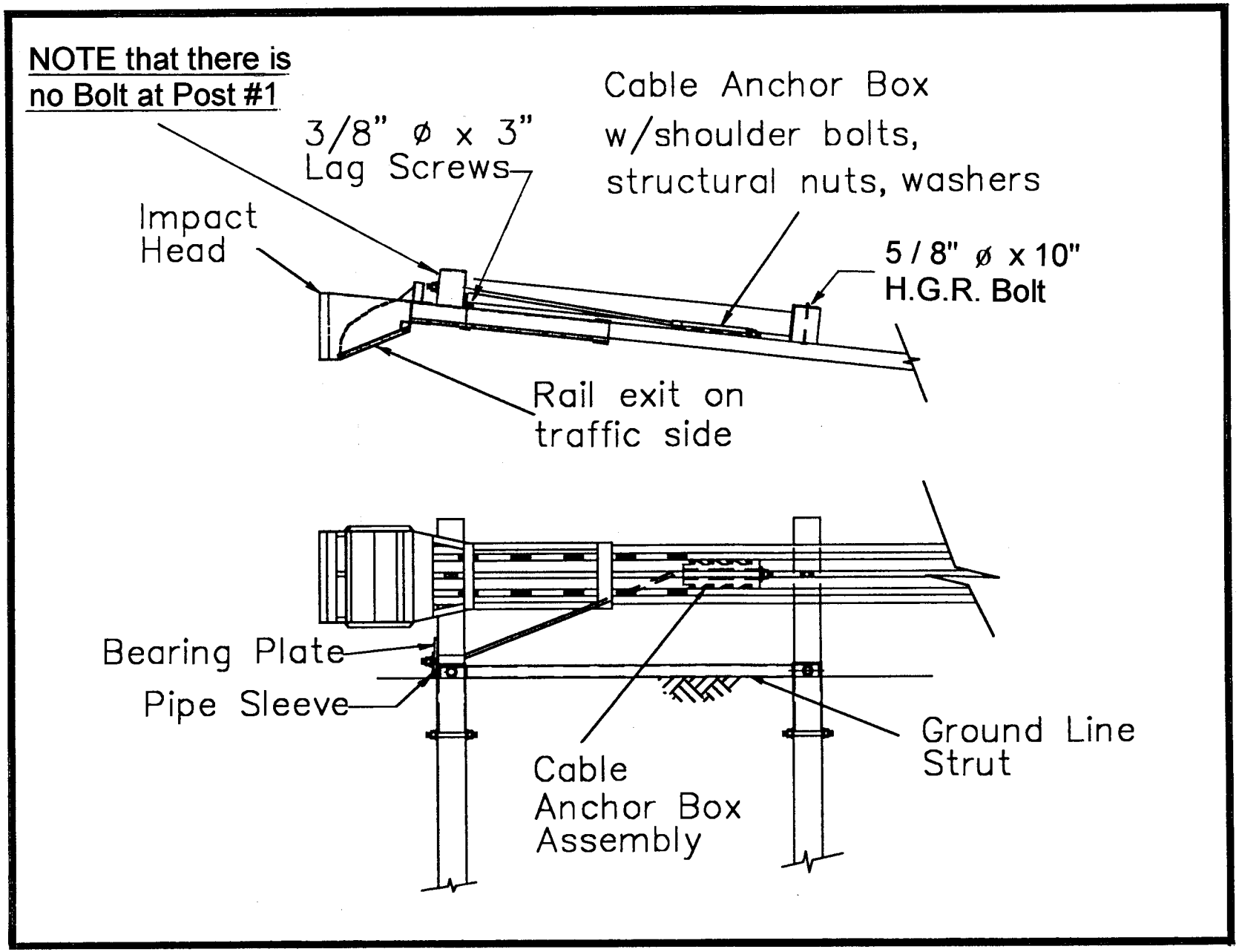
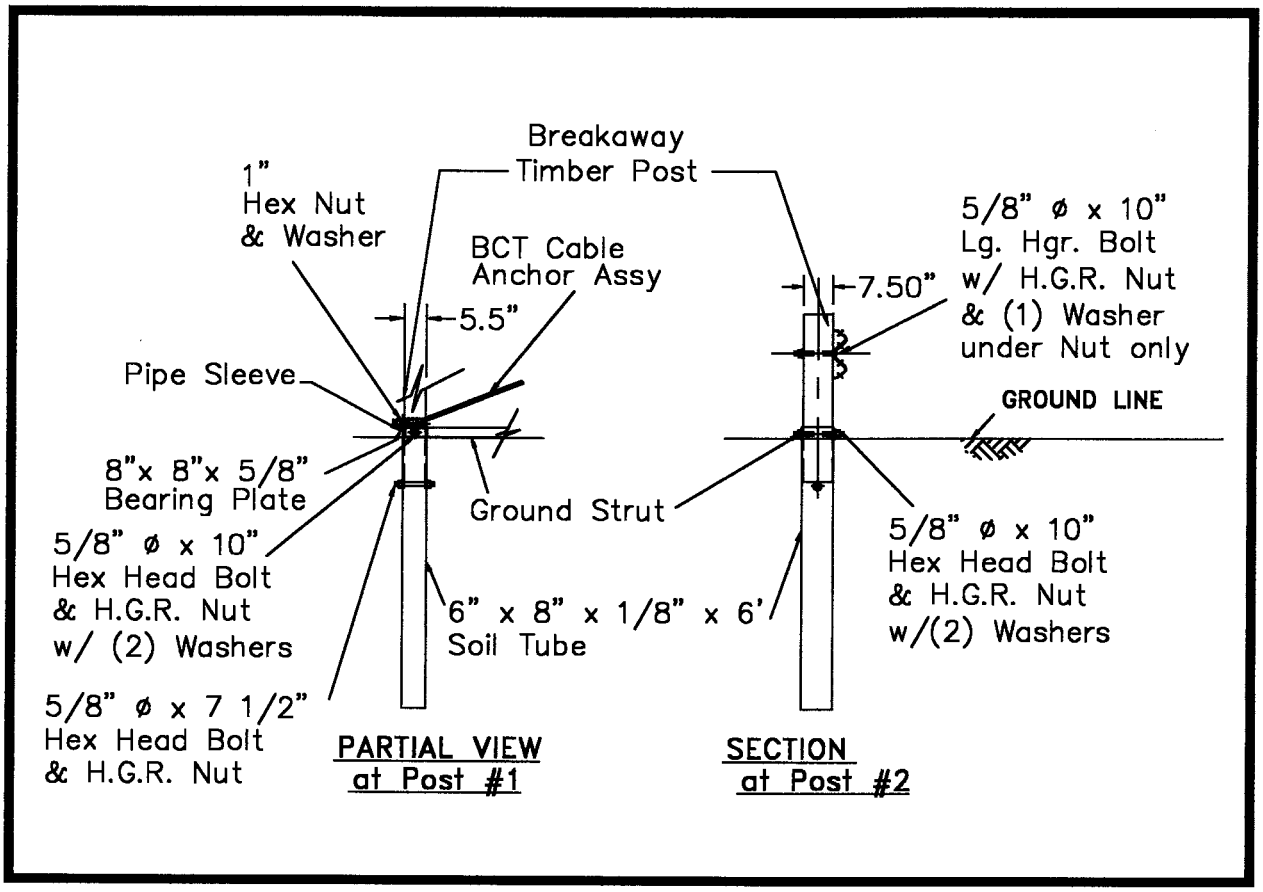


Figure 5. Above-Ground Details at Post Locations 1 and 2.



Note. The optional **6'-0" long split foundation tubes** may be substituted with either **solid 6'-0" long foundation tubes** without soil plates or standard **5'-0" or 4'-6" long foundation tubes** with soil plates.

Figure 6. Section at Post Locations 1 and 2.

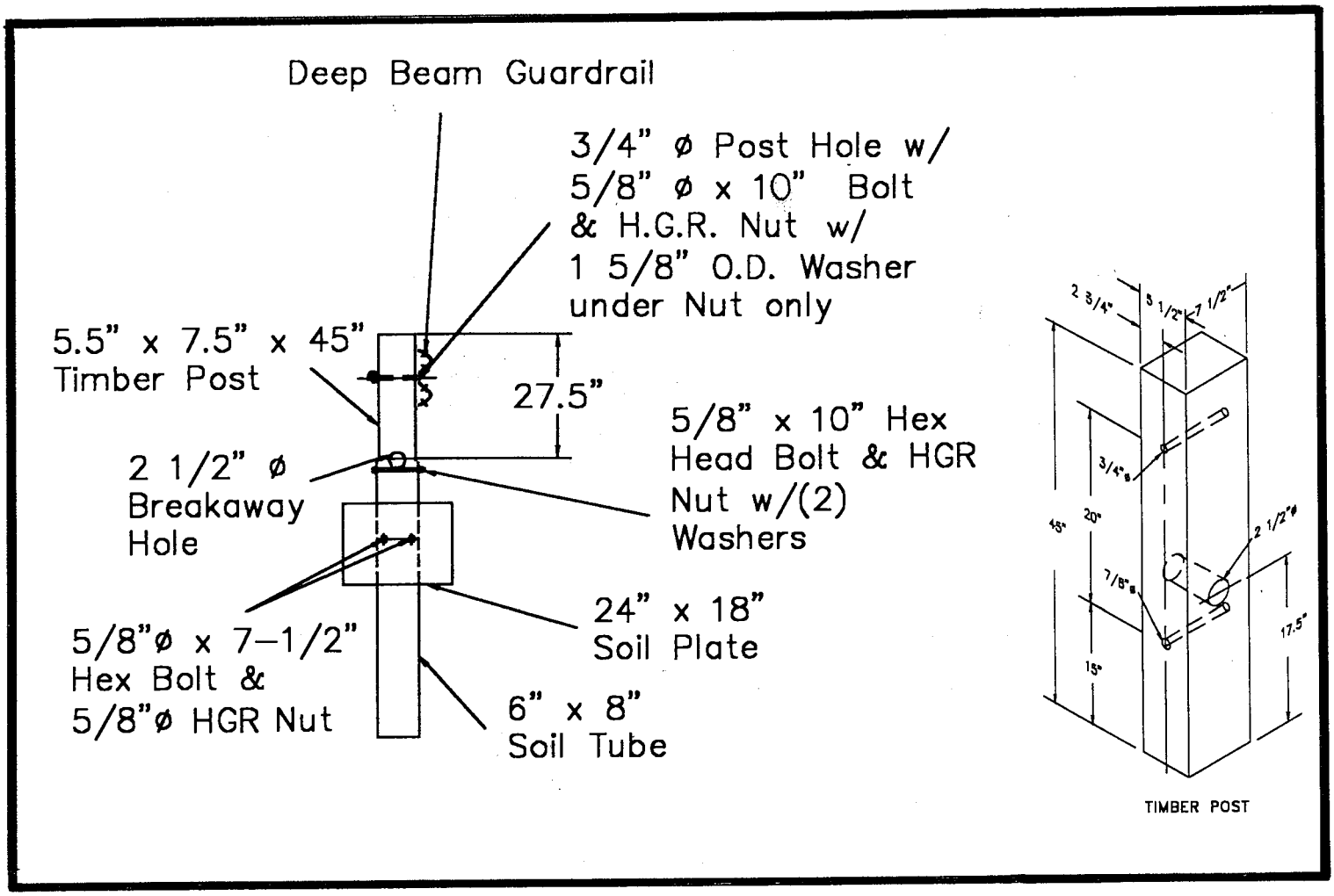


Figure 7. Optional 5'-0" or 4'-6" Foundation Tubes with Soil Plates

Installing Guardrail

The required offset is achieved by first splicing the guardrail panels together and then manually pushing the rails back. Shop curving or bending is not required.

Attach the standard 12'-6" W-beam guardrail section with 6'-3" post spacing (G1203) beginning at post 8 and spanning to post 6. Then attach the standard 12'-6" W-beam guardrail section with 4'-2" post spacing (F1304) which will span from post 6 to post 3. **Note that the rail is not bolted to post #3**. Attach the 12'-6" W-beam guardrail end section (F1303) to span from post 3 to 1. Note that the impact head must be placed over the rail prior to tightening the rail to post # 2. The rail is to be spliced with 5/8″ x 1-1/4″ H.G.R. bolts (B580122) and 5/8″ H.G.R. nuts (N050).

For ease of installation, it is recommended to have the eight 1/2" cable anchor bracket shoulder bolts (SB58A) and the cable anchor bracket (S760) attached to the W-beam guardrail end section prior to attaching the guardrail to the posts. See Section on "Installing Cable Anchor Bracket" for details.

The rails are to be attached to posts and blockouts at post locations 4 through 7 with 5/8″ x 18" H.G.R. bolts (B581802) and nuts (N050). **At post location 3, the rail is not bolted to the post**. The bolt only holds the blockout to the post. There is no blockout on posts 1 and 2, and the rail is attached to post 2 only with a 5/8″ x 10″ H.G.R. bolt (B581002). **Note that no bolt is used at post #1**. Be sure to place a 5/8″ flat washer (W050) on the backside of posts 2 through 7 under each nut (N050).

NOTE: After the blockout is attached, drive a galvanized steel 10d common nail through the block and into the post (toe nailed) to prevent rotation if the wood shrinks.

Installing Cable Anchor Bracket

For ease of installation, it is recommended to have the eight 1/2" cable anchor bracket shoulder bolts (SB58A) and the cable anchor bracket (S760) attached to the W-beam guardrail end section prior to attaching the guardrail to the posts. If this procedure is not followed, Post #2 may interfere with attaching the bracket.

The eight 1/2" cable anchor bracket shoulder bolts (SB58A) are attached to the W-beam guardrail end section with two 1-1/16" OD x 9/16" ID structural washers (W050A), one on each side of the guardrail, and a 1/2" structural nut (N055A). The shoulders of the bolts should be on the backside of the guardrail, away from traffic, as shown in **Figure 8**.

For ease of installation, attach the cable anchor bracket shoulder bolts to the rail "finger tight" only. Then align the slots on the cable anchor bracket (S760) with the shoulder bolts and tap the cable anchor bracket onto the shoulder portion of the bolts using a hammer. Tighten the bolts with a wrench when the bracket is in place. When installed properly, the welded plate on the cable anchor bracket should be toward Post #2, as shown in **Figure 9**.

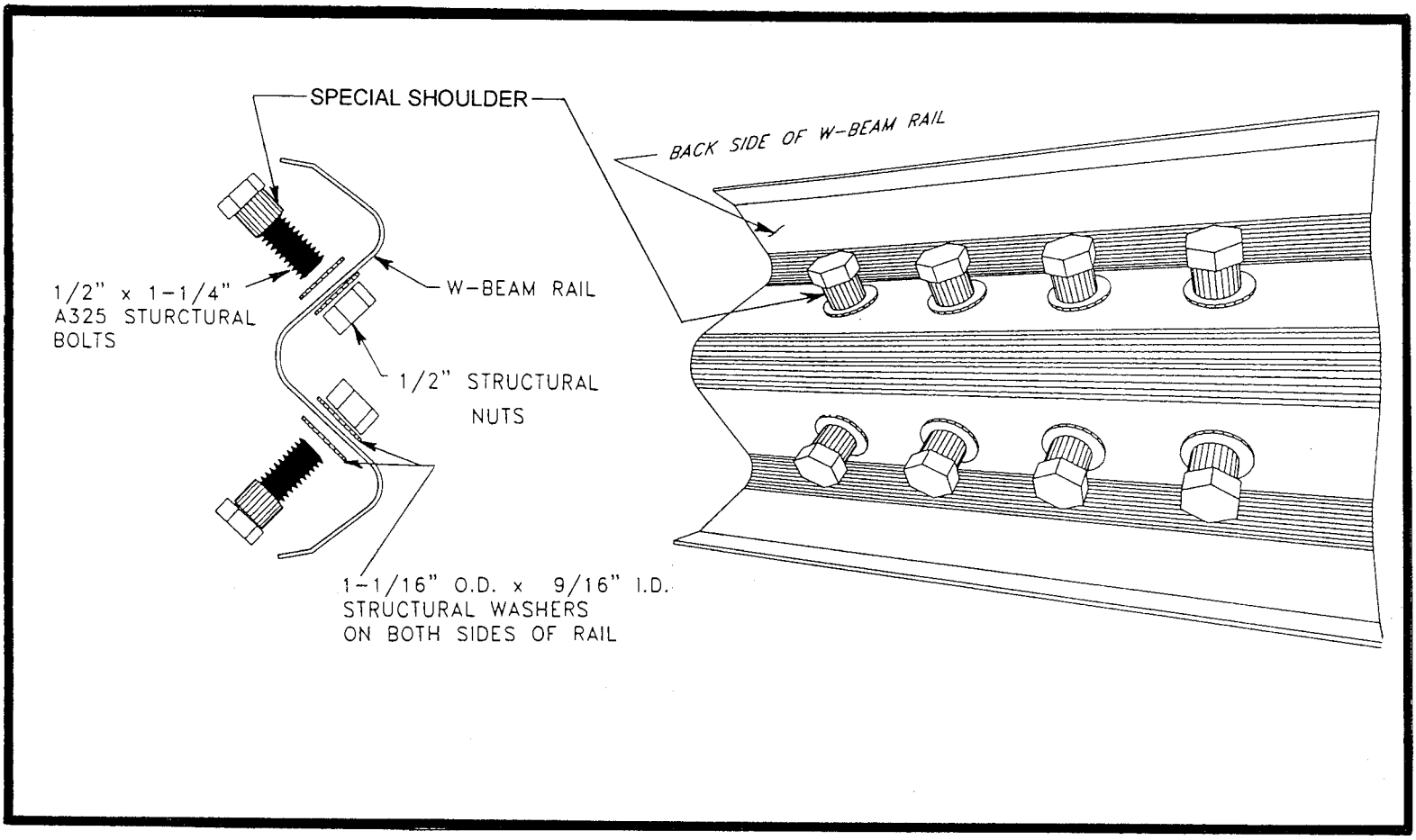


Figure 8. Installation of Cable Anchor Bracket Shoulder Bolts.

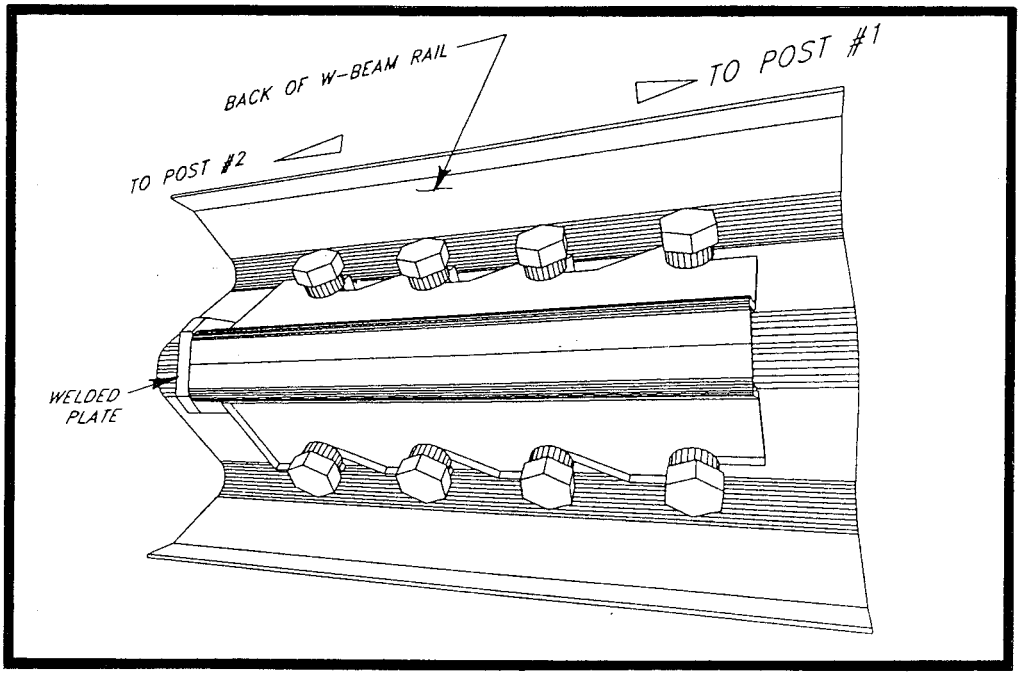


Figure 9. Installation of Cable Anchor Bracket.

Installing the FLEAT 350 Impact Head

The eight cable anchor bracket shoulder bolts and the cable anchor bracket should be attached to the W-beam guardrail end section prior to attaching the ***FLEAT 350*** impact head to the first post with lag screws.

Prior to tightening the rail to post # 2, place the impact head (F3000) with the guide chute over the end of the W-beam guardrail. **The exit slot will be toward the traffic side**. The impact head should be positioned so that the protruding tube is on the backside of the guardrail, away from traffic as shown in **Figure 2** and **Figure 5**. Slide the impact head forward until the post angle attachments on the impact head are aligned with the downstream side of the first post. This is the side facing post #2. Attach the impact head to the first post with two 3/8" x 3" lag screws (E350), one each for the top and bottom post angle attachments. A 1/4" pilot hole is required to avoid breaking the lag screw.

Note. It is recommended that the face of the impact head be delineated with an object marker that meets State specifications for better night visibility. However, the impact face object marker is not included as part of the shipped materials for the ***FLEAT 350*** unless specifically requested in the contract plans.

Installing Cable Assembly

Place the cable assembly (E770) through the cable anchor bracket and through the sleeve of post 1. Place the bearing plate (E750) at the base of post 1 with 5" dimension up and 3" dimension down. Place a nail over the bearing plate to prevent the plate from rotating. Secure both ends of the cable assembly with a 1" hex nut (N100) and washer (W100). While tightening cable, use a 2-lb hammer to tap the cable anchor bracket from the downstream end to ensure that it is securely interlocked with the bolts. Restrain the cable at the end being tightened to avoid twisting the cable.

Upon completion of the installation, the cable should be taut and the cable anchor bracket should be fully seated on the shoulder portion of the cable anchor bolts. *It is very important that the cable anchor bracket be fully seated on the shoulder portion of the cable anchor bolts.*

FLEAT 350 Installation Checklist

State:_____

Date:_____

Project #:_____

Location:_____

- ☐ The rail height is in accordance with the plans (generally 27-3/4″ above the edge of the shoulder).
- ☐ The rail at post #1 is placed at a straight flare (offset between 2'-6" & 4'-0") over the 37'-6" terminal length.
- ☐ The rail is not attached to the post at post location #3 or post location #1.
- ☐ The foundation tubes do not protrude more than 4″ above the ground line (measured by the AASHTO 5' cord method). Site grading may be necessary to meet this requirement.
- ☐ The bolts at the top of the foundation tubes are not over-tightened, deforming the walls of the tubes.
- ☐ The guide chute of the impact head is parallel to the top of the rail and the exit slot of the impact head is facing traffic.
- ☐ The two lag screws holding the impact head to post 1 are snug.
- ☐ The 8″ x 8″ bearing plate at post 1 is correctly positioned with the 5" dimension up & the 3" dimension down. The anchor cable is taut and correctly installed. A nail has been placed over the bearing plate to prevent rotation.
- ☐ The cable anchor bracket shoulder bolts are properly attached to the W-beam guardrail and the cable anchor bracket is fully seated on the shoulder portion of the bolts.
- ☐ Posts #1 and #2 are installed in foundation tubes and have the 2-1/2″ breakaway hole located parallel to the roadway with the bottom of the hole at the top of the tube.
- ☐ CRT posts at locations 3 through 7 have two 3-1/2″ breakaway holes (checked prior to installation) located parallel to the roadway with the center of the top hole located at the ground line.
- ☐ If the posts were augered, be sure the backfill material around the posts is compacted.
- ☐ No washers are used on the face of the rail except at the cable anchor bracket bolts.

Additional notes: _____

_____

Inspection performed by: _____

Repairing the *FLEAT 350*

Equipment Needed for Repair Operation

- Acetylene torch to cut off the damaged rail,
- S.A.E. wrench or socket sizes 9/16", 7/8", 15/16", 1-1/4", and 1-1/2",
- Vice grip or channel lock pliers,
- Sledge hammer,
- Post remover tool (see **Figures 10 and 11**),
- Other normal guardrail tools.

General Repair Procedures

After an end-on impact occurs with the ***FLEAT 350***, it will normally require replacement of the 12'-6" end section of rail and any other damaged rail section(s), any broken post(s) and potentially the impact head. For a traffic face impact, the damage will be to the downstream rail section(s) and associated posts.

The general step-by-step procedure for repairing a damaged ***FLEAT 350*** terminal is as follows:

(1) Check the impact head for damage.

(2) Check the cable anchor bracket and cable assembly for damage. The bearing plate, nuts, washers, cable anchor bracket, and the special cable anchor bracket shoulder bolts are rarely damaged.

(3) Check the number of broken posts and wood blockouts that need to be replaced, along with any damaged bolts. Inventory and pick up the reusable parts.

(4) Torch off the kinked rail near the outlet of the impact head. The impact head should be able to be removed by hand at this point. If not, the impact head is probably not reusable.

(5) Disconnect and remove the damaged rail from the posts.

(6) Remove the broken posts from the foundation tubes using one of the two post removal tools (see **Figures 10 and 11**) assembled from "off the shelf hardware" items. Pound the steel pipe or screw the lag screw into the top of the broken post stub and remove the remains of the broken post by pulling on the chain. Use a pry bar as a lever if necessary.

(7) Reinstall the system following the procedures listed in this manual.

Procedures Immediately Following an Accident (Temporary)

If no repair parts are readily available immediately following an accident, the following procedure should be used to provide temporary protection of the guardrail end. It should be noted that this repair is only for temporary purposes, and the anchor cable cannot be installed to provide tension in the rail for redirectional impacts.

(1) Remove damaged rail and impact head from the roadway or shoulder area.

(2) Using an acetylene torch, cut the kinked rail off at the outlet of the impact head and inspect the head for any damage.

(3) Remove the impact head by hand.

(4) Locate the first post downstream of any damaged rail and cut this rail off about 9″ in front of the post. If the post is at a splice, simply unbolt the damaged rail.

(5) Install the impact head on the rail and attach it to the post with lag bolts.

(6) Warning signs should be used where appropriate.

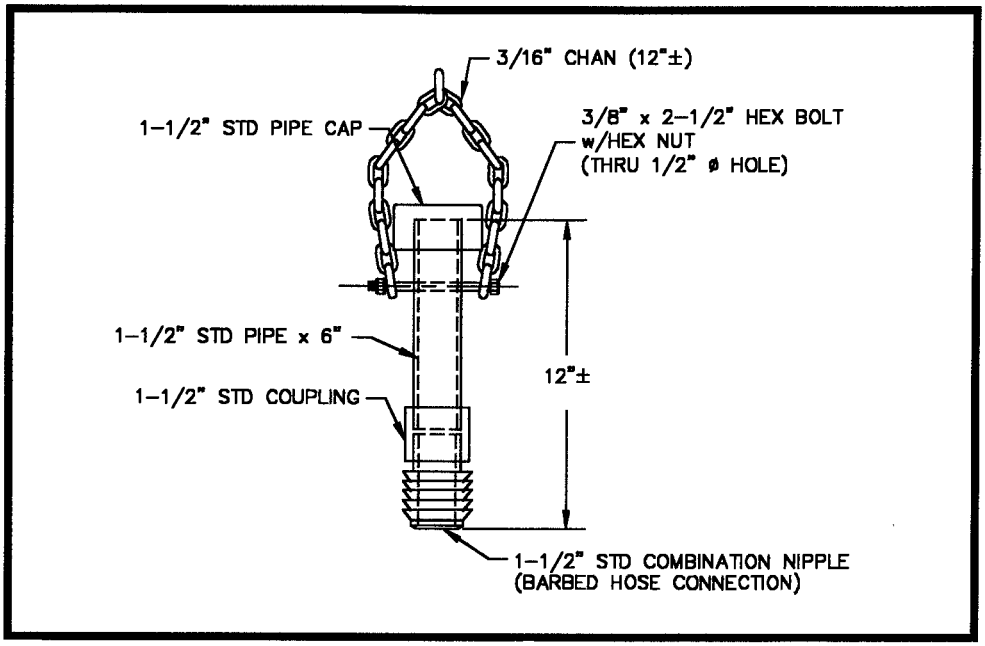


Figure 10. Wood Post Pulling Tool (Pipe Option)

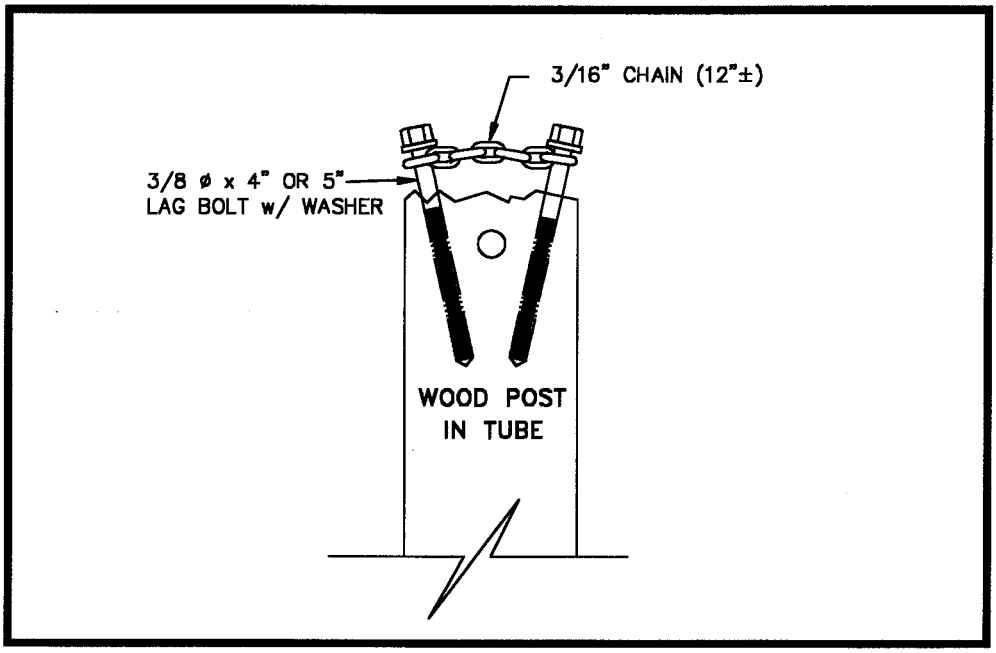


Figure 11. Wood Post Pulling Tool (Lag Screw Option)

NOTES

NOTES

NOTES

Installation Instructions

SRT-350 8 POST™
Guardrail End Treatment
Revised June 24, 2008

TRINITY
HIGHWAY PRODUCTS

HIGHWAY SAFETY SOLUTIONS TODAY

SRT-350 8 POST™ System

Guardrail End Treatment

Installation, Maintenance, and Repair Manual

Trinity Highway Products, LLC
2525 Stemmons Freeway
Dallas, Texas 75207

⚠	**IMPORTANT:** These instructions are to be used only in conjunction with the installation of the SRT-350 8 POST™ system. These instructions are for standard installations specified by the appropriate state/specifying agency. In the event the specified system installation requires or involves special circumstances, contact the appropriate state/specifying agency before proceeding. Trinity Highway Products, LLC (THP) representative is available for consultation if required.

This Manual should be available to the installation/ maintenance/repair workers at all times. For additional copies, contact Trinity Highway Products, LLC at 800-527-6050.

All information, illustrations, and specifications in this Manual are based on the latest SRT-350 8 POST™ system information available at the time of printing. We reserve the right to make changes at any time.

CUSTOMER SERVICE CONTACTS

Trinity Highway Products, LLC is committed to the highest level of customer service. Feedback regarding the SRT-350 8 POST™ system, their installation procedures, supporting documentation, and performance is always welcome. Our goal is to enhance highway safety through innovation. Additional information for materials and product specifications can be obtained by calling the telephone numbers or writing to the email address below:

TRINITY HIGHWAY PRODUCTS, LLC:	
Telephone:	800-644-7976 (U.S. Calls) +1-214-589-8140 (International)
E-mail:	product.info@trin.net
REGIONAL TELEPHONE CONTACTS:	
Dallas, Texas	800-527-6050
Centerville, Utah	800-772-7976
Elizabethtown, Kentucky	800-282-7668
Girard, Ohio	800-321-2755
Orangeburg, South Carolina	800-835-9307
International	+1-214-589-8140

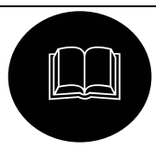
SUGGESTED SAFETY RULES FOR INSTALLATION - MAINTENANCE - REPAIR

*** IMPORTANT SAFETY INSTRUCTIONS ***

Always keep this Manual in a location where it is easily accessed by persons who install, maintain, or repair the SRT-350 8 POST™ system.

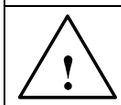
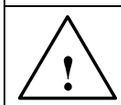
SAFETY SYMBOLS

Below are the safety symbols that may appear on the SRT-350 8 POST™ system or in the documentation. Read the entire Manual for suggested safety, assembly, installation, maintenance, repair, and service information.

SYMBOL	MEANING
	▪ **SAFETY ALERT SYMBOL** Indicates Danger, Warning, or Caution. Failure to read and follow the Danger, Warning, and Safety or Caution indicators could result in serious injury or death to the workers and/or bystanders.
	▪ **WARNING – READ MANUAL** Read the Manual(s) and follow all warnings and safety instructions. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.

WARNINGS AND CAUTIONS

Read all warnings, cautions and instructions before installing/maintaining/ repairing the SRT-350 8 POST™ system.

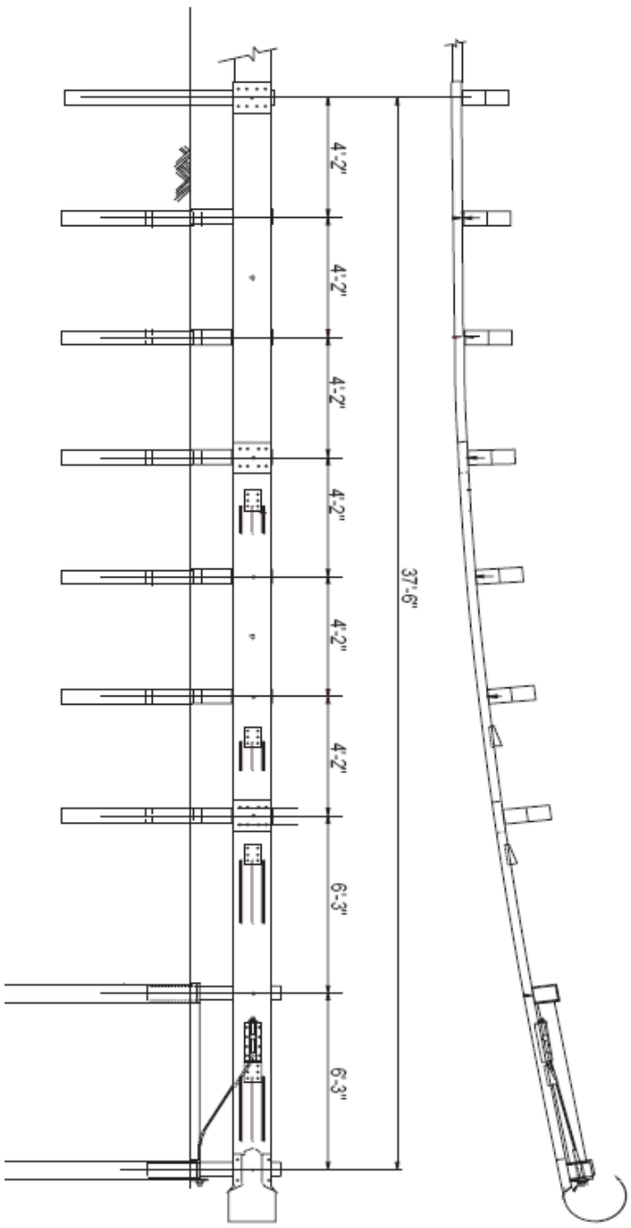
	**IMPORTANT:** READ SAFETY INSTRUCTIONS THOROUGHLY AND FOLLOW THE SAFE OPERATION PRACTICES WHILE INSTALLING THE SRT-350 8 POST™ SYSTEM. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.	
	**WARNING:** Read the instructions carefully. Be familiar with the complete instructions for the SRT-350 8 POST™ system before installing, maintaining, or repairing the SRT-350 8 POST™ system. Failure to follow this warning could result in serious injury or death in the event of a collision.	
	**WARNING:** Ensure that the necessary traffic control is setup and any debris that has encroached onto the traveled way or shoulder has been removed before beginning installation or repairs. Failure to follow this warning could result in serious injury or death in the event of a collision.	
	**WARNING:** Be sure adequate time is available for complete installation, before beginning the installation process. Failure to follow this warning could result in serious injury or death in the event of a collision.	
	**WARNING:** Do NOT perform installation, maintenance, or repair of the SRT-350 8 POST™ system when tired, ill, or under the influence of alcohol, drugs, or medication. Failure to follow this warning could result in serious injury or death in the event of a collision.	
	**WARNING:** Do not install, maintain, or repair the SRT-350 8 POST™ system, until you have read this Manual thoroughly. Please call Trinity Highway Products, LLC at 800-527-7976 if you do not understand the installation instructions. Failure to follow this warning could result in serious injury or death in the event of a collision.	
	**WARNING:** Use only Trinity Highway Products' parts on the SRT-350 8 POST™ system for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with a system that has not been accepted by the Federal Highway Administration ("FHWA"). The SRT-350 8 POST™ system and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.	
	**WARNING:** Do NOT modify the SRT-350 8 POST™ system in any way. Failure to follow this warning could result in serious injury or death in the event of a collision.	
	**WARNING:** Do NOT perform installation, maintenance, or repair, if the SRT-350 8 POST™ system site, shoulder, or traveled area are covered or encroached by road debris. Failure to follow this warning could result in serious injury or death in the event of a collision.	
	**WARNING:** Safety measures, incorporating traffic control devices, must be used to protect all personnel while at the installation, maintenance, or repair site. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders. Trinity Highway Products offers an economical and effective truck mounted attenuator, the MPS-350, for the protection of workers in work zones. For more information on the MPS-350, call 800-644-7976 or visit the Trinity Highway Products website at www.highwayguardrail.com.	
	**WARNING:** Ensure that the entire work zone site is visible at all times for safety. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.	

	**WARNING:** Use caution when working near public roads. Be mindful of vehicles in motion nearby. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.
	**WARNING:** Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.
	**WARNING:** Ensure that your installation, repair, and maintenance meet all appropriate Manual on Uniform Traffic Control Devices (MUTCD) and local standards. Failure to follow this warning could result in serious injury or death in the event of a collision.
	**WARNING:** Ensure that the Guardrail you install is terminated, as dictated by the state/specifying agency, pursuant to FHWA acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.
	**WARNING:** Ensure that there is proper site grading for tube and post placement, as dictated by the state/specifying agency, pursuant to FHWA acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.
	**WARNING:** Ensure that all of the SRT-350 8 POST™ system Warnings, Cautions, and Important statements within the SRT-350 8 POST™ system Manual are followed. Failure to follow this warning could result in serious injury or death in the event of a collision.
	**WARNING:** Always use safety precautions when performing installation, maintenance, repair, mixing chemicals, and/or moving heavy equipment. Wear steel toe shoes, gloves, safety goggles, and back protection. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders.
	**CAUTION:** Ensure before installing, maintaining, or repairing the SRT-350 8 POST™ system that no parts are frayed, damaged, or broken. Failure to follow this warning could result in serious injury to the workers and/or bystanders.

KNOW YOUR SRT-350 8 POST™ SYSTEM

SRT 8-POST™ SYSTEM

FOR SPECIFIC INSTALLATION, MAINTENANCE, OR REPAIR DETAILS, REFER TO THE STATE/SPECIFYING AGENCY'S STANDARD DRAWING



NOTES:	
1.	Alternate to long foundation tube without soil plate is short tube with soil plate.
2.	Alternate to two 12' 6" (3.81 m) long rail panel is one 25' 0" (7.62 m) long rail panel.

SHIPPED - LOOSE PARTS LIST

WARNING: Use only Trinity Highway Products' parts on the SRT-350 8 POST™ system for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with a system that has not been accepted by the Federal Highway Administration ("FHWA"). The SRT-350 8 POST™ system and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.

SRT-350 8-POST ™SYSTEM
BILL OF MATERIAL ENGLISH (METRIC)
(QUANTITIES COULD VARY ACCORDING TO STATE/SPECIFYING AGENCY OPTIONS)

PC	Quantity	Description
9G	1	12/12.5'/6' 3"/S (2.67/3.81/1.905/S) GUARDRAIL
30G	1	12/12.5'/6' 3"/S (2.67/3.81/1.905/S) SRT-1 ANC (GUARDRAIL)
39G	1	12/12.5'/6' 3"/S (2.67/3.81/1.905/S)SRT-2 (GUARDRAIL)
69G	1	12/25'/6' 3"/S (2.67/7.62/1.905/S)SRT-2 (GUARDRAIL)
700A	1	CABLE ANCHOR BRACKET
705G	1	PIPE SLEEVE - 2" STD PIPE x $5^{1}/_{2}$" (50 STD PIPE x 150 PIPE)
740G*	2	6" x 8" x 4' 6" x $^{3}/_{16}$" (152 x 203 x 1375 x 4.8) TUBE SLEEVE
742G	2	6" x 8" x 6' 0" x $^{3}/_{16}$" (152 x 203 x 1830 x 4.8 TUBE SLEEVE (ALTERNATE TO USING 740G and 766G)
766G*	2	18" x 24" x $^{1}/_{4}$" (460 x 610 x 16) SOIL PLATE
775G	1	6" x 8" x $^{5}/_{8}$" (150 x 200 x 16) BEARING PLATE
907G	1	12 (2.67)/BUFFER/ROLLED (TERMINAL)
3000G	1	CABLE ASSEMBLY $^{3}/_{4}$" x 6' 6" (19 x 1981)
3300G	12	$^{5}/_{8}$" (16) WASHER
3340G	(Varies)	$^{5}/_{8}$" HGR NUT
3360G	(Varies)	$^{5}/_{8}$" DIA. x $1^{1}/_{4}$" (16 DIA. x 35) HGR SPLICE BOLT
3380G	8	$^{5}/_{8}$" DIA. x $1^{1}/_{2}$" (16 DIA. x 40) HEX HEAD BOLT
3478G*	4	$^{5}/_{8}$" DIA. x $7^{1}/_{2}$" (16 DIA. x 190) HEX HEAD BOLT
3497G	2	$^{5}/_{8}$" DIA. x $9^{1}/_{2}$" (16 DIA. x 240) HEX HEAD BOLT
3500G	2	$^{5}/_{8}$" DIA. x 10" (16 DIA. x 255) HGR POST BOLT
3580G	6	$^{5}/_{8}$" DIA. x 18" (16 DIA. x 460) HGR POST BOLT
3900G	1	1" (25) WASHER
3910G	2	1" (25) HEX NUT
4063B	6	WOOD POST 6" x 8" x 6' 0" (150 x 200 x 1830)
4075B	6	WOOD BLOCK 6" x 8" x 14" (150 x 200 x 360) DR
5968G	14	16d NAIL SRT
6058B	2	WOOD POST $5^{1}/^{2}$" x $7^{1}/_{2}$" x 3' 9" (140 x 190 x 1145)
9852A	1	STRUT
9960G	4	SLOT GUARD
9961G	1	$^{3}/_{8}$" x 3" x 4" (10 x 75 x 100) PLATE WASHER

* OPTION TO THE 6' 0" POST SLEEVE TUBE

Delineation Options

PC	Quantity	Description
6665B	1	16" x 16" (400 x 400) Striped (Yellow/Black) REFLECTIVE SHEETING **Note:** See state/specifying agency's MUTCD for options or proper delineation.

INSTALLING THE SRT-350 8 POST™ SYSTEM

Use Trinity Highway Products' drawings for the SRT-350™ 8 POST system with these instructions. Review the state/specifying agency's standard drawing(s) for this system, details will be specific to the project or site locations. The installation of the SRT-350 8 POST™ system is similar to the Breakaway Cable Terminal (BCT) installation. The same equipment and expertise is required for both systems.

	**WARNING:** Ensure that there is proper site grading for tube and post placement as dictated by the state/specifying agency, pursuant to FHWA acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.
	**WARNING:** Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.

MATERIALS

As packaged, the SRT-350 8 POST SRT system includes all materials needed for the installation of the 37' 6" (11.43 m) of the SRT-350 8 POST™ system. Note that concrete footings or foundations are NOT required.

TOOLS REQUIRED

The following list shows required tools for **installation** of the SRT-350 8 POST™ system:

- Calibrated tape measure
- $^{9}/_{16}$" (14 mm) Socket or Wrench
- $^{15}/_{16}$" (24 mm) Socket or Wrench
- $1^{1}/_{4}$" (32 mm) Socket or Wrench
- $1^{1}/_{2}$" (38 mm) Socket or Wrench
- Augers
- Post pounders (commonly used in driving posts)
- Vise grip pliers

The following list shows recommended tools for the **repair** of the SRT-350 8 POST™ system. However, since repair is directed by the state/specifying agency, they may have more specific guidelines.

- Channel lock pliers
- Sledge hammer
- Post removal tool and other normal guardrail tools
- Eye bolts connected to heavy duty chain (to remove the posts from tubes)
- Vehicle to pull the posts from the tubes

SITE PREPARATION

Site grading is usually necessary for the proper placement of the steel tubes and the Control Release Terminal ("CRT") posts. Use the state/specifying agency's standard specifications and drawings for the site grading. Trinity does not direct grading. Complete this grading before the start of the installation of the SRT-350 8 POST™ system.

	**WARNING:** Ensure that there is proper site grading for tube and post placement as dictated by the state/specifying agency, pursuant to FHWA acceptance. Failure to follow this warning could result in serious injury or death in the event of a collision.

INSTALLATION

The post installation of the SRT-350 should be per the following Post Installation Section. If the system is installed on a curve, see figures on page 16 for the layout. If there are special field conditions encountered when installing the SRT-350 8 POST™ system, contact the state/specifying agency. Trinity Highway Products, LLC at 1-800-644-7976, is available to assist the state/specifying agency, if needed.

POST INSTALLATION

Complete the following instructions for the installation of the CRT posts and the foundation tubes with wood posts.

POST LAYOUT

Complete the following steps and use the table below to layout the posts for the SRT-350 8 POST™ system:

Step	Actions
1.	Start at the **location 9** end of the Guardrail run that is the connection point for the terminal. The length of the installation is 37' 6" (11.43 m).
2.	Layout the post locations starting at **location 8**, which is the first offset post. (Dimensions are from a tangent line along the back of the Guardrail to the center of the post.)
3.	Measure the offset points from a tangent line of the Guardrail run extending from **post 9** towards **post 1**.
4.	Locate the offset points by chord measurements at the center of the post, equal to the post spacing.
5.	Ensure that the Posts are approximately tangent to the railing at each post location.

POST LAYOUT MEASUREMENTS TABLE						
Post Location	**Offsets**					
	3'	**(.91 m)**	**3.5'**	**(1.07 m)**	**4'**	**(1.22 m)**
	Ft.	**mm**	**Ft.**	**mm**	**Ft.**	**mm**
9	1.00	305	1.00	305	1.00	305
	4' 2" (1270 mm) Post Spacing					
8	1.00	305	1.00	305	1.05	320
	4' 2" (1270 mm) Post Spacing					
7	1.00	305	1.06	325	1.20	365
	4' 2" (1270 mm) Post Spacing					
6	1.06	325	1.23	375	1.45	440
	4' 2" (1270 mm) Post Spacing					
5	1.25	380	1.50	460	1.79	545
	4' 2" (1270 mm) Post Spacing					
4	1.56	475	1.88	570	2.22	675
	4' 2" (1270 mm) Post Spacing					
3	1.97	600	2.36	720	2.76	840
	6'3" (1905 mm) Post Spacing					
2	2.17	660	2.62	805	3.10	945
	6'3" (1905 mm) Post Spacing					
1	3.30	1005	3.80	1160	4.30	1320

INSTALLING THE CRT POSTS

Complete the following steps to install the CRT posts:

Step	Actions
1.	Install the wood posts (PC-4063B) at **locations 8 through 3**, spaced at 4' 2" (1270 mm) apart. Select Option A or Option B for the post installation.

Option A	Drive posts into the ground.
Option B	1. Drill 12” (300 mm) maximum diameter holes approximately 44" (1120 mm) deep. 2. Insert the 6' 0" (1830 mm) wood post into these holes. 3. Backfill the hole with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction. **Note:** If compactable, the material removed from the hole may be used for the backfill.

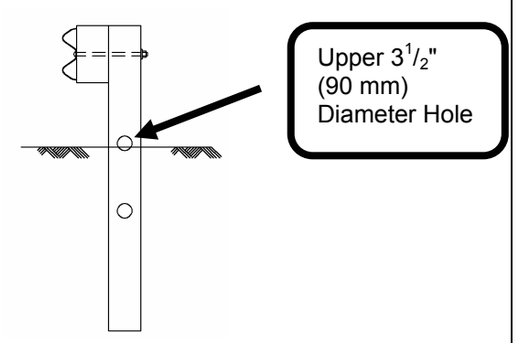


Figure 1

Note: In either option within the previous step, the bottom of the upper $3^1/_2$" (90 mm) diameter hole in the post is approximately at the finished grade. (See Figure 1)

PLACING FOUNDATION TUBES FOR WOOD POSTS

Complete the following steps to position foundation tubes and wood posts:

TUBE OPTIONS

Step	Actions
1.	Select Option A or Option B for this installation.

Option A	**6' 0" (1830 mm) Tube, no Soil Plate** 1. No assembly required. 2. Install the foundation tube (PC-742G), as described below.
Option B	**4' 6" (1375 mm) Tube with Soil Plate** 1. Assemble the soil tubes and soil plates. 2. Insert two (2) $^5/_8$" x $7^1/_2$" (16 mm x 190 mm) Hex Head Bolts through the soil plate (PC-766G) and the foundation tube (PC-740G). 3. Place HGR nuts (no washers) on the inserted bolts to secure. Tighten the bolts to a snug position. (There is no torque requirement for these bolts.) 4. Install the foundation tube (PC-766G) with soil plate as described below.

Note: Do not over tighten the bolts and deform the tubes, as that will complicate possible post replacement.

Step	Actions
2.	Install the foundation tubes at **locations 1 and 2**. Use the strut as a guide for the spacing of the tubes. Position the soil plate on the side of the post, away from the impacting end, if applicable. **Note:** Do not drive tubes with the wood post inserted, as that will complicate possible post replacement.

INSTALLATION OPTIONS FOR FOUNDATION TUBES

Select the steps below for Permeable Soil or Non-Permeable Soil to install foundation tubes:

FOR PERMEABLE SOIL

Step	Actions
1.	If the soil is permeable (water will drain from the tubes), drive the tubes with an approved driving head to the optimum height where the top of the tube is $2^{5}/_{8}$" (67 mm) above the finished grade. **Note:** Take extra care to prevent settlement or lateral displacement of the tubes, to ensure the posts attach to the Guardrail correctly.
2.	Ensure that the finished Guardrail height will be approximately $27^{3}/_{4}$" (706 mm) above the finished grade, or as the state/specifying agency plans indicate, by placing a wood post in the tube and checking the height of the bolt hole. Correct, if needed.
3.	Ensure that the tubes do not project more than 4" (100 mm) above the finished grade.

FOR NON-PERMEABLE SOIL

Step	Actions
1.	Select Method A, Method B, or Method C below, if soil is non-permeable. **Method A** **For Tube Only** 1. Drill a 12" (300 mm) diameter pilot hole approximately 75" (1905 mm) deep. 2. Insert the tube into the hole to the optimum height where the top of the tube is $2^{5}/_{8}$" (67 mm) above the finished grade. **For Tube with Soil Plate** 1. Drill a 12" (300 mm) diameter pilot hole approximately 75" (1905 mm). 2. Insert the soil plate/tube assembly into the hole by impact or vibratory means with an approved driving head. 3. Drive the tube to the optimum height where the top of the tube is $2^{5}/_{8}$" (67 mm) above the finished grade. **Method B** Cut slots for the soil plates out by hand or by using a rock bar. Follow all of the steps of Option A, above. **Method C** Drill three adjacent 12" (300 mm) diameter holes or one 24" (610 mm) diameter hole to accommodate the soil plate/tube assembly. Follow all of the steps of Option A, above. **Note:** If Option C is used, material must be placed in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction. **Note:** Take extra care to prevent settlement or lateral displacement of the tubes, to ensure the posts attach to the Guardrail, correctly.

Step	Actions
2.	Ensure that the finished Guardrail height will be approximately $27^{3}/_{4}$" (706 mm) above the finished grade, or, as the state/specifying agency plans indicate, by placing a wood post in the tube and checking the height of the bolt hole. Correct, if needed.
3.	Ensure that the tubes do not project more than 4" (100 mm) above the finished grade.

INSTALLING TUBES WHEN ENCOUNTERING ROCK

Complete the following steps to install foundation tubes when encountering rock:

Step	Actions
1.	Select Option A or Option B below when encountering rock, unless there is a more restrictive state/specifying agency specification.

Option A	**If rock is encountered with 20" (510 mm) or less depth for full installation** 1. Drill a 12" - 16" (300 mm - 400 mm) diameter hole into the rock 2" (50 mm) deeper than required full embedment depth. 2. Place granular material or small pieces of the drilled rock in the bottom 2" (50 mm) of the hole for drainage. 3. Insert the tube into the hole to the proper mounting height. 4. Backfill the hole with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction. (If compactable, the material removed from the hole may be used for the backfill.) 5. Ensure that the finished Guardrail height is approximately $27^{3}/_{4}$" (706 mm) above the finished grade, or as the state/specifying agency plans indicate. 6. Ensure that the tubes do not project more than 4" (100 mm) above the finished grade. **Note:** Take extra care to prevent settlement or lateral displacement of the tubes, to ensure the posts attach to the Guardrail, correctly.
Option B	**If rock is encountered with greater than 20" (510 mm) depth for full installation** 1. Drill a 12" - 16" (300 mm - 400 mm) diameter hole 22" (560 mm) deep into the rock. 2. Insert the tube into the hole and measure from the bottom of the tube to the finished grade. 3. Determine the proper length of tube to install to ensure the tube is fully embedded in the hole and does not project more than 4” (100 mm) above the finished grade. (The optimum height for tube projection is $2^{5}/_{8}$”.) 4. Remove tube from the hole. Measure and mark from the top of the tube the length to remove from the bottom. 5. Cut off the measured length from the bottom of the tube. 6. Place granular material or small pieces of the drilled rock in the bottom 2" (50 mm) of the hole for drainage. Continues on next page.

	7. Insert the tube in the hole to the proper mounting height. 8. Backfill the hole with compactable materials in 6" (150 mm) lifts and compact with pneumatic equipment to optimum compaction. (If compactable, the material removed from the hole may be used for the backfill.) 9. Ensure that the finished Guardrail height is approximately $27^{3}/_{4}$" (706 mm) above the finished grade, or as the state/specifying agency plans indicate. 10. Ensure that the tubes do not project more than 4" (100 mm) above the finished grade. **Note:** Take extra care to prevent settlement or lateral displacement of the tubes, to ensure the posts attach to the Guardrail, correctly.

INSTALLING WOOD POSTS IN TUBES

Complete the following steps to install wood posts in tubes:

Step	Actions
1.	Insert the Pipe Sleeve (PC-705G) in post (PC-6058B) and install in steel tube at **location 1**. **Note:** A metal band must be around the post under the post bolt hole.
2.	Install second (PC-6058B) post in steel tube at **location 2**. **Note:** A metal band must be around the post under the post bolt hole.

INSTALLING THE STRUT

Complete the following steps to install the strut:

Step	Actions
1.	Place the slotted yokes of the ground strut (PC-9852A) over the top of the foundation tubes for **posts 2 and 1**.
2.	Place a washer on a $^{5}/_{8}$" X $9^{1}/_{2}$" (16 mm x 240 mm) Hex Head Bolt.
3.	Insert the bolt through the strut, foundation tube, and the wood post from the embankment side.
4.	Install a second washer and a nut on the inserted bolt. Tighten the bolt to a snug position. (There is no torque requirement for these bolts.) **Note:** Do not over tighten the bolt and deform the tubes, as that will complicate possible post replacement.

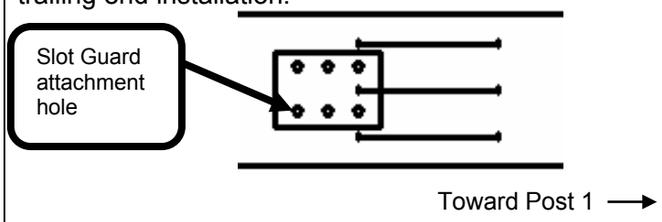
INSTALLING WOOD BLOCKOUTS AT POSTS 8 & 7

Complete the following steps to install the Wood Blockouts at posts 8 and 7:

Step	Actions
1.	Insert a $^{5}/_{8}$" x 18" (16 mm x 460 mm) post bolt through the Wood Blockout (PC-4075B) and the post at **posts 8 and 7**. **Note: Do not bolt the Guardrail panel to posts 8 and 7**.
2.	Place a round washer under a Hex Nut on the inserted bolt to secure. Tighten the bolt to a snug position. (There is no torque requirement for these bolts.)

ARRANGING RAIL PANELS

Complete the following steps to arrange the rail panels:

Step	Actions
1.	Layout that Guardrail panels (PC-30G and PC-39G and PC-69G) with slots between **posts 6 and 5**, **4 and 3**, **3 and 2**, and **2 and 1**.
2.	Position the Guardrail panels so that the Slot Guard attachment holes are at the end of the slots away from **Post 1**. (See Figure 2) Position the Guardrail panels and Slot Guards the same for a trailing end installation.  **Figure 2**
3.	Ensure that the 12' 6" (3.81m) Guardrail panel (PC-39G) or 25' 0" (7.62 m) Guardrail panel (PC-69G) slots are between **posts 6 and 5** and **posts 4 and 3**.
4.	Ensure that the 12' 6" (3.81m) Guardrail panel (PC-30G) anchor bracket holes are between **posts 2 and 1**.

INSTALLING RAIL PANELS

Complete the following steps to install the rail panels:

Step	Actions
1.	Splice and post bolt the 12' 6" (3.81m) rail panel (PC-9G) or the 25' 0" (7.62 m) rail panel (PC-60G) at **post 9** to the run of Guardrail. Use hardware provided by the standard Guardrail supplier. **Note:** Lap the terminal rail in the direction of traffic, unless the state/specifying agency's policy dictates otherwise.
2.	Select Option A or Option B for this installation.

Option	
A	**For Installing Two 12' 6" (3.81 m) Panels** 1. Splice the 12' 6" (3.81m) rail panel to the other 12' 6" (3.81m) rail panel (PC-39G) at **post 6**, with eight (8) $^{5}/_{8}$" x $1^{1}/_{4}$" (16 mm x 32 mm) Splice Bolts and Hex Nuts. 2. Insert a $^{5}/_{8}$" x 18" (16 mm x 460 mm) post bolt through the rail panel, Wood Blockout, and the wood post, at **posts 6, 5 and 4**. 3. Place a round washer under a Hex Nut on the inserted bolt to secure. Tighten the bolt to a snug position. (There is no torque requirement for these bolts.) 4. Splice the 12' 6" (3.81 m) rail panel (PC-39G) to the other 12' 6" (3.81 m) rail panel (PC-30G) , at **post 3**, with eight (8) $^{5}/_{8}$" x $1^{1}/_{4}$" (16 mm x 32 mm) Splice Bolts and Hex Nuts. 5. Insert a $^{5}/_{8}$" x 18" (16 mm x 460 mm) post bolt through the rail panels, Wood Blockout, and the wood post at **post 3.** 6. Place a round washer under a Hex Nut on the inserted bolt to secure. Tighten the bolt to a snug position. (There is no torque requirement for these bolts.) 7. Insert a $^{5}/_{8}$" x 10" (16 mm x 255 mm) post bolt through the rail panel and the post, at **posts 2 and 1.** 8. Place a round washer under a Hex Nut on the inserted bolt to secure. Tighten the bolt to a snug position. (There is no torque requirement for these bolts.)

Option B	**For Installing One 25' 0" (7.62 m) Panel** 1. Insert a $^{5}/_{8}$" x 18" (16 mm x 460 mm) post bolt through the 25' 0" (7.62 m) rail panel (PC-69G), Wood Blockout, and the wood post, at **posts 6, 5, and 4**. 2. Place a round washer under a Hex Nut on the inserted bolt to secure. Tighten the bolt to a snug position. (There is no torque requirement for these bolts.) 3. Splice the 25' 0" (7.62 m) rail panel to the 12' 6" (3.81 m) rail panel (PC-30G), at **post 3**, with eight (8) $^{5}/_{8}$" x $1^{1}/_{4}$" (16 mm x 32 mm) Splice Bolts and Hex Nuts. 4. Insert a $^{5}/_{8}$" x 18" (16 mm x 460 mm) post bolt through the rail panels, Wood Blockout, and the wood post at **post 3.** 5. Place a round washer under a Hex Nut on the inserted bolt to secure. 6. Tighten the bolt to a snug position. (There is no torque requirement for these bolts.) 7. Insert a $^{5}/_{8}$" x 10" (16 mm x 255 mm) post bolt through the rail panel and the wood posts, at **posts 2 and 1**. 8. Place a round washer under a Hex Nut on the inserted bolt to secure. Tighten the bolt to a snug position. (There is no torque requirement for these bolts.)

TOE NAILING THE WOOD OFFSET BLOCKS

Complete the following step to toe nail the wood offset blocks to the posts:

Step	Actions
1.	Toe nail the wood offset blocks at all post locations with 16d hot-dipped galvanized nails to prevent the blocks from rotating. Install the nails approximately 3" (75 mm) from the top of the post or block, one on each side of the block.

INSTALLING THE SLOT GUARDS

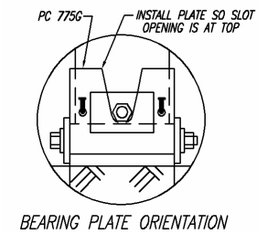
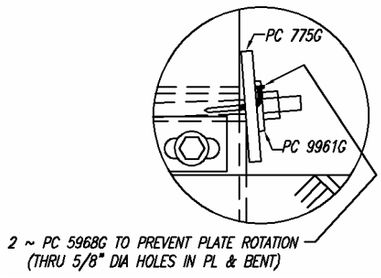
Complete the following steps to install the Slot Guards:

Step	Actions
1.	Place the Slot Guards (PC-9960G) against the backside of the Guardrail panels with the deflector angle gap opening toward (closest to) the elongated slots. Align the six holes in the Slot Guard with the six holes in the Guardrail panel near the elongated slots.
2.	Bolt each Slot Guard to the backside of the Guardrail panels with six (6) $^{5}/_{8}$" x $1^{1}/_{4}$" (16 mm x 32 mm) Splice Bolts and Hex Nuts.

INSTALLING THE CABLE ANCHOR ASSEMBLY

Complete the following steps to install the cable anchor assembly:

Step	Actions
1.	Place a round washer on each of the eight (8) $^{5}/_{8}$" x $1^{1}/_{2}$" (16 mm x 38 mm) Hex Head Bolts needed.
2.	Insert the bolts through the traffic side of the rail panel and the Cable Anchor Bracket (PC-700A) on the backside of the Guardrail panel. Secure the Hex Head Bolts with a Hex Nut on each bolt. Tighten each bolt to a snug position. (There is no torque requirement for these bolts.)
3.	Slide one end of the cable (PC-3000G) into the Cable Anchor Bracket and the other end through the Pipe Sleeve (PC-705G) in **post 1**.
4.	Place a 1" (25 mm) washer and a 1” (25 mm) Hex Nut on the end of the cable that extends through the Cable Anchor Bracket. Tighten the nut, until at least 2 threads are completely through the nut.

Step	Actions
5.	Place the Bearing Plate (PC-775G), so that the open side of the V-notch is at the top and connect it to **post 1**, by driving a nail through each of the 2 holes provided. Bend the nails to attach the Bearing Plate. (See Figures 3 and 4.)  **Figure 3**  **Figure 4**
6.	Place the Plate Washer (PC-9961G) and a 1" (25 mm) Hex Nut on the end of the cable that extends through **post 1**.
7.	Restrain the cable with vise grip pliers at the end being tightened, to avoid twisting the cable.
8.	Tighten the Hex Nuts on the cable ends, until the cable is taut. The cable is considered taut, when it does not deflect more than 1 inch, when pressure is applied by hand in an up or down direction.

INSTALLING THE END SECTION AND DELINEATION

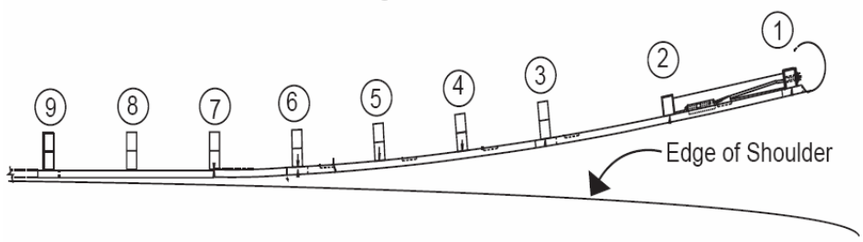
Complete the following steps to install the end section and delineation:

Step	Actions
1.	Connect the end section (PC-907G) to the end of the Guardrail panel with four (4) $^{5}/_{8}$" x $1^{1}/_{4}$" (16 mm x 32 mm) Splice Bolts and Hex Nuts. Tighten the bolts to a snug position. (There is no torque requirement for these bolts.)
2.	Install high intensity reflective sheeting (PC-6665B) on the front face of the end section, per the state/specifying agency's MUTCD for options or proper delineation. **Note:** The reflective sheeting is an option to the SRT-350 8 POST™ and needs to be ordered separate from the SRT-350 8 POST™ package. **WARNING:** Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.

LAYOUT OF SRT-350 8 POST™ SYSTEM ON A CURVE

Outside of Curve

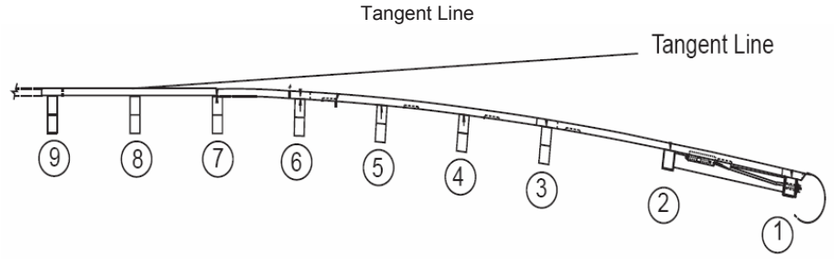
Edge of Shoulder



The SRT-350 8 POST™ system offsets are measured at the edge of shoulder from the start of the SRT-350 8 POST™ system.

Inside of Curve

Tangent Line



The SRT-350 8 POST™ system offsets are measured at a tangent line from the start of the SRT-350 8 POST™ system. If an offset places a post on the shoulder, then the face of the rail must be on the edge of the shoulder for that offset.

Note: Refer to Post Layout Measurement table on page 8 of this Manual.

INSTALLATION CHECKLIST

STATE: _____PROJECT: _____

DATE: _____LOCATION: _____

- ❑ The finished Guardrail height is approximately $27^{3}/_{4}$" (706 mm) above the finished grade, or as the state/specifying agency plans indicate.
- ❑ Any site grading needed was completed, before the start of the installation of the SRT-350 8 POST™ system.
- ❑ The steel tubes do not protrude more than 4" (100 mm) above the finished grade measured by the American Association of State Highway and Transportation Officials ("AASHTO") 5' 0" (1.5 m) cord method. Site grading may be necessary to meet this requirement.
- ❑ The bolts at the top of the steel tubes are not over tightened. The walls of the steel tubes are not collapsed.
- ❑ The 6" x 8" (150 mm x 200 mm) Bearing Plate at **post 1** is correctly positioned and the anchor cable is taut and correctly installed (it should be rechecked after installation to be sure it has not relaxed). The taut cable does not deflect more than 1 inch, when pressure is applied by hand in an up or down direction. A nail is driven through each of the holes and bent to prevent the plate from rotating.
- ❑ The rail panel is not attached to **posts 7 and 8**.
- ❑ No rectangular washers are used on the face of the rail.
- ❑ Slot Guards are in place against the backside of the Guardrail panels with the deflector angle gap opening toward (closest to) the elongated slots.
- ❑ Rail panels are oriented correctly and lapped in the direction of traffic, unless the state/specifying agency's policy dictates otherwise.
- ❑ All blockouts have been toe nailed to the posts with 16d hot-dipped galvanized nails.
- ❑ If backfilled, the backfill material around the posts is properly compacted.
- ❑ The CRT post has two $3^{1}/_{2}$" (90 mm) breakaway holes (checked prior to installation). The breakaway holes are located parallel to the roadway with the bottom edge of the top hole located approximately at the finished grade.
- ❑ The tube bolts are installed with the nuts on the pavement side of the tube for ease of future removal.
- ❑ **Posts 1 and 2** have metal bands around them, under the post bolt hole.

MAINTENANCE AND REPAIR INSTRUCTIONS

*** IMPORTANT MAINTENANCE AND REPAIR INSTRUCTIONS ***

Always keep this Manual in a location where it is easily accessed by persons who install, maintain, or repair the SRT-350 8 POST™ system. If you have any questions concerning the information in this Manual or about the SRT-350 8 POST™ system, contact the state/specifying agency, then Trinity Highway Products, LLC at 800-527-6050.

	**WARNING:** Use only Trinity Highway Products' parts on the SRT-350 8 POST™ system for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with a system that has not been accepted by the Federal Highway Administration ("FHWA"). The SRT-350 8 POST™ system and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.
	**WARNING:** Ensure that the necessary traffic control is setup and any debris that has encroached onto the traveled way or shoulder has been removed before beginning installation or repairs. Failure to follow this warning could result in serious injury or death in the event of a collision.
	**WARNING:** Safety measures incorporating traffic control devices must be used to protect all personnel while at the installation, maintenance, or repair site. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders. Trinity Highway Products offers an economical and effective truck mounted attenuator, the MPS-350, for the protection of workers in work zones. For more information on the MPS-350, call 800-644-7976 or visit the Trinity Highway Products website at www.highwayguardrail.com.
	**WARNING:** Do NOT perform installation, maintenance, or repair if the SRT-350 8 POST™ system site, shoulder, or traveled area are covered or encroached by road debris. Failure to follow this warning could result in serious injury or death in the event of a collision.
	**WARNING:** Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.

MAINTENANCE

Complete the following steps, periodically, to check the safety of the system:

Step	Actions
1.	Ensure the nuts have not been removed from the cable. Replace nuts, if needed.  **WARNING:** Use only Trinity Highway Products' parts on the SRT-350 8 POST™ system for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with a system that has not been accepted by the Federal Highway Administration ("FHWA"). The SRT-350 8 POST™ system and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.
2.	Ensure the cable is taut. The cable is considered taut, when it does not deflect more than 1 inch when pressure is applied by hand in an up or down direction. Tighten, if needed.
3.	Ensure Wood Blocks are in place and in good condition, as defined by the state/specifying agency.
4.	Ensure the blockouts have not rotated. Correct the blockout position and reinstall the toe nails, if needed.

REPAIR

Complete the following steps to repair the SRT-350 8 POST™ system:

Step	Actions
1.	Setup necessary traffic control at the accident site and then remove any debris that has encroached onto the traveled way or shoulder.  **WARNING:** Ensure that the necessary traffic control is setup and any debris that has encroached onto the traveled way or shoulder has been removed before beginning installation or repairs. Failure to follow this warning could result in serious injury or death in the event of a collision.  **WARNING:** Safety measures incorporating traffic control devices must be used to protect all personnel while at the installation, maintenance, or repair site. Failure to follow this warning could result in serious injury or death to the workers and/or bystanders. Trinity Highway Products offers an economical and effective truck mounted attenuator, the MPS-350, for the protection of workers in work zones. For more information on the MPS-350, call 800-644-7976 or visit the Trinity Highway Products website at www.highwayguardrail.com.
2.	Take inventory of the damaged system and determine what parts are reusable as defined by the state/specifying agency and what parts need to be replaced.
3.	Obtain the Trinity Highway Products' parts that need to be replaced from Trinity Highway Products, LLC (See page 7 of this Manual for list of recommended tools for the repair of the SRT-350 8 POST system.)  **WARNING:** Use only Trinity Highway Products' parts on the SRT-350 8 POST™ system for installation, maintenance, or repair. The installation or co-mingling of unauthorized parts is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with a system that has not been accepted by the Federal Highway Administration ("FHWA"). The SRT-350 8 POST™ system and its component parts have been accepted for state use by FHWA. However, a co-mingled system has not been accepted.
4.	Return to the repair site with the replacement parts and tools needed.
5.	Disconnect and remove the damaged rail from the posts.
6.	Remove the broken posts from the steel tubes.
7.	Remove any damaged CRT posts.
8.	Reconstruct the system following the installation instructions, after the site has been cleared of damaged debris.  **WARNING:** Do NOT perform installation, maintenance, or repair if the SRT-350 8 POST™ system site, shoulder or traveled area are covered or encroached by road debris. Failure to follow this warning could result in serious injury or death in the event of a collision.
9.	Install proper delineation for the repaired SRT-350 in accordance with the state/specifying agency's MUTCD.  **WARNING:** Ensure that all Guardrail products and delineation used meet all federal, state/specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death in the event of a collision.

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BARRIER SYSTEMS

A LINDSAY TRANSPORTATION SOLUTIONS COMPANY

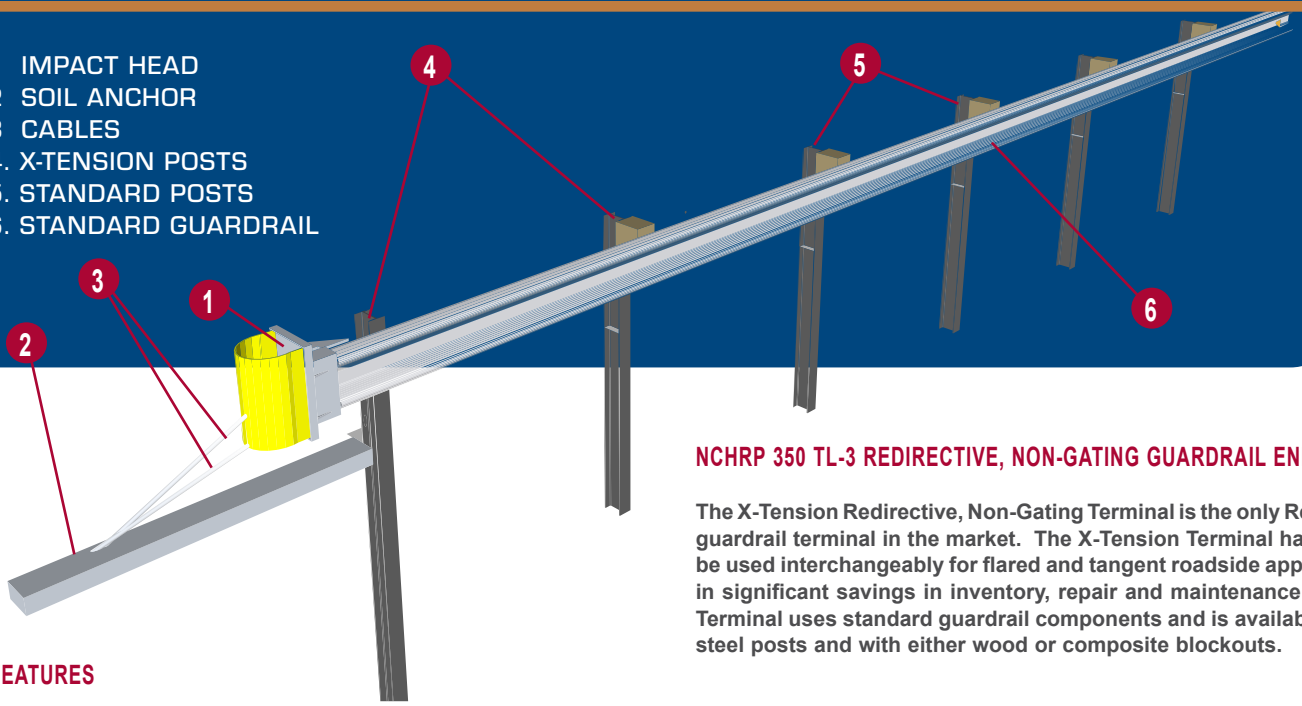
X-Tension™

Redirective, Non-Gating Guardrail End Terminal

- Contractor Friendly
- Simple Installation
- Meets NCHRP 350 TL-3

X-Tension™ Redirective, Non- Gating Terminal

1 IMPACT HEAD
2 SOIL ANCHOR
3 CABLES
4. X-TENSION POSTS
5. STANDARD POSTS
6. STANDARD GUARDRAIL



NCHRP 350 TL-3 REDIRECTIVE, NON-GATING GUARDRAIL END TERMINAL

The X-Tension Redirective, Non-Gating Terminal is the only Redirective, Non-Gating guardrail terminal in the market. The X-Tension Terminal has been engineered to be used interchangeably for flared and tangent roadside applications. This results in significant savings in inventory, repair and maintenance costs. The X-Tension Terminal uses standard guardrail components and is available with either wood or steel posts and with either wood or composite blockouts.

FEATURES

- Only NCHRP 350 tested Redirective Non-Gating Guardrail Terminal available
- Available in 727 or 787mm [28.5 or 31"] heights
- Uses same components for tangent or flared applications
- Easy to install
- Utilizes many standard guardrail components

WHERE TO USE

Side of road where limited clear zone or excessive slope restricts the use of Redirective Gating terminals.

REDIRECTIVE NON-GATING

The X-Tension Terminal can be installed either flared or tangent.

PHYSICAL SPECIFICATIONS

Length	12 m [40']
Width	572 mm [22.5"]
Height	727 / 787mm [28.5/31"]
Weight	534 kg [1179 lb]
Test Level	NCHRP 350 TL-3

FREQUENTLY ASKED QUESTIONS

WHAT MAKES THE X-TENSION TERMINAL DIFFERENT FROM THE OTHER END TERMINALS ON THE MARKET?
The X-Tension Terminal is tested to NCHRP 350 as a Redirective Non-Gating System. All other terminals are tested as Redirective Gating Systems, meaning they will only start to redirect at the third post.

IS A TRANSITION NEEDED TO ATTACH TO STANDARD GUARDRAIL?
The X-Tension Terminal is designed to attach directly to guardrail with no transition required.

CAN THE X-TENSION TERMINAL BE ATTACHED TO CONCRETE BARRIER?
The X-Tension Terminal can be attached to concrete barrier with the addition of standard transitions.

CAN THE X-TENSION TERMINAL BE INSTALLED USING COMPOSITE BLOCKOUTS?
The X-Tension Terminal can be ordered with either wood or composite blockouts.

DISTRIBUTED BY:

General details for the X-Tension Terminal are subject to change without notice to reflect improvements and upgrades. Additional information is available from Barrier Systems, Inc.

BARRIER SYSTEMS

A LINDSAY TRANSPORTATION SOLUTIONS COMPANY

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